SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Return to Aquatic Invasive Species

Gary D. Czypinski
U.S. Fish and Wildlife Service
Ashland Fishery Resources Office
Ashland, WI 54806
gary_czypinski@fws.gov

Anjanette K. Bowen
U.S. Fish and Wildlife Service
Alpena Fishery Resources Office
145 Water Street, Federal Building - #203
Alpena, MI 49707
989/356-5102-14
anjanette_bowen@fws.gov

Michael A. Goehle
U.S. Fish and Wildlife Service
Lower Great Lakes Fishery Resources Office
405 North French Road, Suite 120A
Amherst, NY 14228
716/691-5456-32
michael_goehle@fws.gov

Beth Brownson
Ontario Ministry of Natural Resources
Fish and Wildlife Branch
Biodiversity Section, 2nd Floor N.
300 Water St., P.O. Box 7000
Peterborough, Ontario K9J 8M5
705/755-1950
beth.brownson@mnr.gov.on.ca

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INTRODUCTION

The ruffe (*Gymnocephalus cernuus*), an Eurasian percid, was likely introduced to the St. Louis River Estuary (SLRE), MN/WI, during the mid 1980s in the ballast water of an ocean-going ship (Pratt *et al*. 1992). Ruffe increased rapidly and became the most abundant fish in the SLRE by 1990, based on bottom trawl assessment. The population peaked at about eight million in trawls by 1995 and subsequently declined to about two million in trawls by 2004; however, ruffe remained the most abundant species in trawls through 2004; the U.S. Geological Survey (USGS) terminated bottom trawl assessments in the SLRE after 2004 (unpublished, USGS, Great Lakes Science Center, Lake Superior Biological Station, Ashland, Wisconsin). In 1991, ruffe were detected in Thunder Bay Harbour, Ontario, (Busiahn 1997). Due to potential competition for food and space, ruffe pose a threat to native fish populations (Ruffe Task Force 1992).

Experimental research conducted by the University of Minnesota-Duluth revealed that ruffe consume a significant amount of benthic macroinvertebrate energy (Schuldt *et al*. 1999). In a presentation of this experiment, co-author Carl Richards, University of Minnesota Natural Resources Research Institute, stated in conclusion: "With the significant amount of benthic macroinvertebrate energy that ruffe are consuming in the St. Louis River Estuary, something has got to be happening in that ecosystem. We are just not seeing it yet". In the same experiment, research also demonstrated significant declines in the growth of yellow perch (*Perca flavescens*), at ruffe densities less than, equal to, and greater than the densities of yellow perch (Henson 1999). However, a statistical analysis of bottom trawl data conducted by USGS showed no significant relationship between an increasing ruffe population and declining native fish populations in the St. Louis River, MN/WI (Bronte *et al*. 1998).

In three Wisconsin tributaries just east of the St. Louis River, 1995-2002 trawl data suggests that yellow perch abundance declines in years that ruffe abundance increases (Evrard *et al*. 1998), (Czypinski *et al*. 2002). This trend was analyzed and found to be weakly significant for all three tributaries combined (unpublished, D. H. Ogle, Department of Mathematics, Northland College, Ashland, WI).

As a result of increasing abundance and expansion outside the SLRE and speculation of potential impacts on native fish populations, the Aquatic Nuisance Species Task Force declared the ruffe to be a "nuisance species" in the spring of 1992. By authority of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, this designation authorized the formation of a control committee charged with the responsibility of designing and implementing a control plan. The *Ruffe Control Program* was drafted in 1995 with a revision in 1996 after ruffe were discovered in Lake Huron in 1995 (Kindt *et al*. 1996).

> The goal of the *Ruffe Control Program* is **"to prevent or delay the spread of ruffe in the Great Lakes and inland waters"** (Ruffe Control Committee 1996). Surveillance was one of eight objectives designed into the program to achieve this goal.

Formal ruffe surveillance efforts began in 1992 to detect pioneering populations of ruffe in the Great Lakes (Slade and Kindt 1992). These efforts were initiated by the U.S. Fish and Wildlife Service (USFWS) - Ashland Fishery Resources Office (Ashland FRO) and the Ontario Ministry of Natural Resources (OMNR) - Lake Superior Management Unit.

The term *ruffe surveillance* as used herein is defined as efforts designed and implemented specifically to find and collect ruffe.

The term *other fish sampling* as used herein is defined as efforts implemented to assess a fishery (including sea lamprey (*Petromyzon marinus*) assessments), in which ruffe are not specifically the target species, but the gear used is capable of capturing ruffe. In reporting other fish sampling, we describe results of fishery sampling using gear that is capable of capturing ruffe, but the sampling was not dedicated to that purpose. Fishery assessment methods and results were provided to us per our request to fishery management and/or research agencies working in the Great Lakes. This is not a complete list of fishery sampling using gear that is capable of capturing ruffe, only that which was reported or known to us.

Following is a chronology of ruffe detection for the Great Lakes Basin:

1986: Ruffe were discovered in the SLRE (Duluth-Superior Harbor), Minnesota/Wisconsin, by the Wisconsin Department of Natural

Resources (WDNR). This was the initial sighting of ruffe in North America.

1991: Major ruffe range expansion was detected. A crew from Ashland FRO discovered ruffe in Thunder Bay Harbour, Ontario, 293 km northeast of the SLRE along the north shore of Lake Superior. This introduction was likely a ballast water transfer from shipping operating between the Duluth/Superior Harbor, Minnesota/Wisconsin and Thunder Bay Harbour.

1992: Major ruffe range expansion was detected. Ashland FRO initiated formal ruffe surveillance, and located several new populations along the south shore of Lake Superior, thus extending the known range of ruffe to the Sand River, Wisconsin, 60 km east of the SLRE.

1993: Major ruffe range expansion was detected. Ashland FRO discovered eight new locations

colonized by ruffe in Lake Superior. Ruffe unexpectedly passed by Chequamegon Bay, Wisconsin, to the Bad River, Wisconsin, 156 km east of the SLRE (Busiahn 1997). At the Bad River, ruffe were poised to enter Michigan waters of Lake Superior. USFWS - Lower Great Lakes Fishery Resources Office (LGLFRO) initiated ruffe surveillance in U.S. waters of Lakes Erie and Ontario (Slade *et al*. 1994). No ruffe were detected in the Lower Great Lakes.

1994: Major ruffe range expansion was detected. Ashland FRO discovered ruffe at five new locations in Lake Superior, the farthest of which was the Ontonagon River, Michigan, 276 km east of the SLRE. OMNR-LSMU also captured ruffe in Thunder Bay Harbour, Ontario, Lake Superior, where they had not been caught since 1991 (Slade *et al*. 1994). No ruffe were detected in the Lower Great Lakes.

1995: Major ruffe range expansion was detected. Ashland FRO discovered ruffe in Lake Huron near the mouth of the Thunder Bay River, Alpena, Michigan; this discovery was 480 km east of the Ontonagon River, Michigan (Busiahn 1997). The Thunder Bay River, Michigan, was the only confirmed location where ruffe have been captured outside of Lake Superior, and it became the periphery of the ruffe range in the Great Lakes. This introduction into Lake Huron was likely an assisted range expansion from ballast water release. No ruffe were detected in the Lower Great Lakes.

1996: No ruffe range expansion was detected. USFWS - Alpena Fishery Resources Office (Alpena FRO) assumed ruffe surveillance for U.S. waters of Lake Huron and one site in northern Lake Michigan. OMNR-LSMU captured eight ruffe, the largest single-year catch since trawling began in Thunder Bay Harbour, Ontario in 1991 (Czypinski *et al*. 1997). Five of these specimens were young-of-the-year (YOY) indicating that successful reproduction was occurring in tributaries flowing into Thunder Bay. No ruffe were detected in the Lower Great Lakes.

1997: Some interior ruffe range expansion was detected. Ruffe were discovered in three new locations within their known range in Lake Superior. OMNR conducted ruffe surveillance in Canadian waters of Lake Huron. Ruffe catch rates at peripheral locations were approximately less than or equal to previous years. No ruffe were detected in the Lower Great Lakes. Many agencies, as well as the public, contributed to the ruffe surveillance effort by providing voluntary reports of incidental captures.

1998: No ruffe range expansion was detected, but ruffe became the most abundant species captured during fall bottom trawling ruffe surveillance in the Thunder Bay River, Michigan, a peripheral range location. OMNR expanded ruffe surveillance into Canadian waters of Lake Erie, and LGLFRO added fall surveys to their ruffe surveillance locations. However, no ruffe were detected in the Lower Great Lakes.

1999: Only minor ruffe range expansion was detected. Ashland FRO detected ruffe in one new location in Lake Superior, the Firesteel River, Michigan, representing a range expansion of 12 km eastward along the south shore of Lake Superior. The catch per unit effort (CPE) of ruffe in the Thunder Bay River Estuary, Lake Huron, increased from 1 per minute bottom trawling in 1998 to 11 per minute bottom trawling. The majority of the Thunder Bay River ruffe catch were YOY, and ruffe remained the most abundant species captured in trawls from this location. Round goby were first captured from the Thunder Bay River, Lake Huron. No ruffe were detected in the Lower Great Lakes.

2000: No ruffe range expansion was detected. Ruffe catch rates at peripheral locations (Thunder Bay, Harbour, Ontario, Lake Superior, and Thunder Bay River, Michigan, Lake Huron) were less than or equal to previous years. The exception was the Ontonagon River, Michigan, Lake Superior, where the mean ruffe CPE (No./Hr. bottom trawling) more than doubled from 5 in 1999

to 11. The CPE of ruffe in the Thunder Bay River Estuary, Lake Huron declined from 11 to 0.3 per minute bottom trawling. Round goby were the most abundant species captured from the Thunder Bay River during ruffe surveillance. No ruffe were detected in the Lower Great Lakes.

2001: Minor ruffe range expansion was detected. OMNR detected ruffe near the mouth of the Current River, Lake Superior, which is located within Thunder Bay Harbour, Ontario. This discovery represents a range expansion of 8 km eastward along the north shore of Lake Superior. A large catch of YOY ruffe from one bottom trawl tow in the Ontonagon River, Michigan, increased the mean CPE (No./Hr. bottom trawling) of that colony more than 7 fold to 78. However, no ruffe were captured east of the Ontonagon River along the south shore of Lake Superior. Using a 38 mm stretch mesh gill net (15 m panel), the Red Cliff Tribal Fisheries Dept. in cooperation with Ashland FRO attempted to capture ruffe during a lake whitefish spawning assessment near the Apostle Islands, Lake Superior. The objective of this effort was to investigate potential ruffe predation on lake whitefish eggs; no ruffe were captured in this one-night effort. No ruffe were captured from the Thunder Bay River colony or any other ruffe surveillance location in Lake Huron. No ruffe were detected in the Lower Great Lakes.

2002: Major ruffe range expansion was detected. Ashland FRO discovered ruffe in Lake Michigan near Escanaba, Michigan, and in the Keweenaw Waterway, Lake Superior, 101 km east of the Ontonagon, River, Michigan, the previous eastern boundary of the ruffe range along the south shore of Lake Superior. In the Ontonagon River, although trawling indicated a decline in ruffe abundance from 2001, the overall trend in ruffe abundance continues to increase. No ruffe expansion was detected in Lake Huron, and no ruffe were captured in trawls within the ruffe range in Lake Huron. Alpena FRO initiated reduction of the spawning ruffe population in the Thunder Bay River, Lake Huron, with a 38 mm stretch mesh gill net (30.5 m panel); a total of 96 ruffe were captured in 52 nights effort. The Red Cliff Tribal Fisheries Dept. in cooperation with Ashland FRO continued a ruffe capture effort during lake whitefish spawning near the Apostle Islands, Lake Superior; no ruffe were captured in this one-night gill net effort. Due to unseasonably cold weather, no ruffe surveillance was conducted in Thunder Bay Harbour, Ontario, the eastern boundary of the ruffe range along the north shore of Lake Superior. No ruffe were detected in the Lower Great Lakes.

2003: Minor ruffe range expansion was detected in Thunder Bay Harbour, Ontario, Lake Superior, and in Little Bay de Noc, Lake Michigan. However, ruffe CPE in trawls increased significantly in Thunder Bay Harbour from 78/hour in 2000 to 569/hour in 2003. In addition, round goby (*Neogobius melanostomus*) and white perch (*Morone americana*) were discovered in Thunder Bay Harbour, the second confirmed location for round goby in Lake Superior. Ruffe surveillance was expanded in Lake Michigan by Ashland and Green Bay FRO's to include a total of nine major ports, but no ruffe were captured outside of Little Bay de Noc. Ruffe were not captured from new locations in Lake Huron; however, they continue to persist in the Thunder Bay River, Michigan.

The Red Cliff Tribal Fisheries Dept. in cooperation with Ashland FRO continued a ruffe capture effort during lake trout and lake whitefish spawning near the Apostle Islands, Lake Superior. A total of nine adult ruffe were captured in 19 net-nights; no eggs of any species were found in the ruffe diet analysis. In Lake Huron, the Alpena FRO continued reduction of spawning ruffe in the Thunder Bay River, removing a total of ten ruffe in 74 nights of gill net effort. In Lake Superior, a combination of bottom trawling, gill netting, and trapping conducted by the Ashland FRO failed to effectively (achieve a minimum reduction of 90% of the ruffe population) reduce the ruffe spawning population in the Ontonagon River Estuary, Michigan. Totals of 65, 16, and 4 ruffe were removed in 5.2 hours of trawling effort, 23 nights of trapping effort, and 2.9 hours of gill netting (30.5 m panel) effort respectively. A bycatch of 62 stocked juvenile lake sturgeon (*Acipenser fulvescens*) were also captured, standard data was recorded, and all sturgeon were released alive. No ruffe were detected in the Lower Great Lakes.

2004: Major ruffe range expansion was detected. Ashland FRO discovered ruffe in Marquette Harbor, Michigan, Lake Superior, 110 km east of the Sturgeon River Sloughs, Keweenaw Waterway, the previous detected eastern boundary of the ruffe range along the south shore of Lake Superior. The Michigan Department of Natural Resources (MIDNR) discovered ruffe in Big Bay de Noc, Lake Michigan, 15 km east of Little Bay de Noc. Little Bay de Noc was the location of initial discovery of ruffe in Lake Michigan in 2002. Ruffe were not captured from new locations in Lake Huron, nor were they captured from the Thunder Bay River, Michigan; however, they continue to persist in the Thunder Bay River. Ruffe remain undetected in the Lower Great Lakes, and in all inland lakes and streams within the Great Lakes Basin.

2005: In Lake Superior, minor range expansion was detected. The USGS-Lake Superior Biological Station captured one sub-adult ruffe incidentally from Thunder Bay, Ontario, 5 km northeast of Thunder Bay Harbour, Ontario, the previous eastern boundary of the ruffe range along the north shore of Lake Superior. The MIDNR captured one mature ruffe incidentally from Torch Lake, a new location within the Keweenaw Waterway; ruffe were first detected in the Keweenaw Waterway in 2002. The Ashland FRO captured one mature ruffe from lower Marquette Harbor, Michigan, where ruffe were first detected in 2004. Marquette Harbor continues to be

the eastern boundary of the ruffe range along the south shore of Lake Superior.

In Lake Huron, no ruffe were captured from new or previously detected locations, including the Thunder Bay River and Thunder Bay shipping lanes, where they were first detected in 1995. In Lake Michigan, MIDNR captured no ruffe in other fish sampling from Big Bay de Noc, where they were first detected in 2004. However, MIDNR captured a total of 22 ruffe in other fish sampling from Little Bay de Noc, where ruffe were first detected in 2002. The Bays de Noc of northern Green Bay continue to comprise the ruffe range in Lake Michigan. No ruffe were captured from the Lower Great Lakes, where they remain undetected as well as in all inland lakes and streams within the Great Lakes Basin.

The following report summarizes ruffe surveillance and other reported fish sampling capable of capturing ruffe incidentally, on the periphery and outside of the detected range of ruffe in the Great Lakes Basin during 2005.

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OBJECTIVES

The primary objective of ruffe detection activities is early detection and description of age and/or size composition. The secondary objectives are to describe the fish community at each location surveyed, and to monitor peripheral range locations where ruffe had been previously detected, such as Thunder Bay Harbour, Ontario, the Keweenaw Waterway, Michigan, and Marquette Harbor, Michigan.

These objectives address the needs of the Ruffe Control Program (Ruffe Control Committee 1996) by defining the range of ruffe and detecting reproducing populations on the periphery of the range. Early detection of range expansion minimizes rate of spread by public awareness, and voluntary ballast water management by the Great Lakes maritime industry.

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METHODS

U.S. Waters of the Great Lakes

Ruffe surveillance was concentrated in habitat defined as cloudy, turbid, or stained water with little light penetration and soft substrate. These areas included estuaries, embayments, tributary mouths, canals, and in or near shipping ports. We focused on areas that ruffe could potentially colonize through ballast water from inter- and intra-lake shipping. Ruffe surveillance usually concentrated in the deepest habitat at the site as determined by electronic depth sounders, but depths from 3-8 meters were targeted when available, which compares to the depth range in the SLRE. This included natural channels, dredged shipping channels, and pools. However, ruffe surveillance was not limited to these areas; shallow areas in rivers and areas with heavy vegetation (sloughs) were also surveyed.

The primary gear used in each of the Great Lakes was a 4.9 m bottom trawl, commercially manufactured with a 3.8 cm stretch mesh body, a 31.8 mm stretch mesh cod end, and a 12.7 mm stretch mesh inner liner to hold small specimens. Bottom trawls were pulled with a variety of vessels and were deployed and retrieved either by hand or with a winch powered hydraulically, electrically, or by gasoline engine. The target time for trawl tows was 5 to 10 minutes per tow, but varied in duration depending on the size of the area trawled, the presence of submerged obstacles, and numbers of fish captured. Tow speed was maintained at approximately 3 km/hour, and was monitored by commercially manufactured trolling speed indicators or engine tachometer readings.

In addition to bottom trawls, other gear employed included mini fyke nets and experimental perch traps (called modified Windermere traps) (Edwards *et al*. 1998). The mini fyke nets consisted of 0.7 m x 1.0 m rectangular hoops interconnected with 6.35 bar length x 12.7 mm stretch mesh netting and a 15 m lead net. The modified Windermere traps measure 0.6 m x 1.2 m with netting consisting of a 6.35 mm bar length x 12.7 mm stretch mesh. The diameter of the trap entrance holes measure 5.08 to 6.35 cm. The modified Windermere traps were baited with nightcrawlers, except one trap per set was left unbaited for catch comparison monitoring.

The term *established location* as used herein refers to a geographic body of water that was selected for ruffe surveillance based on the risk of invasion by ruffe. The risk was assessed by the amount of habitat known to be attractive to ruffe (i.e. deep channels and pools, low water clarity, soft substrate).

The term *established transect* as used herein is defined as a fixed bottom trawl tow or trap site selected for ruffe surveillance within an established location based on its probability of containing ruffe. The probability of containing ruffe was assessed by the combination of habitat characteristics known to be attractive to ruffe.

Bottom water temperature was recorded prior to each established trawl tow (transect), except when consecutive tows were conducted in close proximity to each other. Depth was recorded at the start and finish of individual tows and then averaged to determine the mean depth for each tow. The mean depths of all tows at an established location were averaged to calculate the mean depth at that established location. Tows were directed along and across contours, but the majority were along contour. For established trap sites (transects), depth was recorded, and bottom water temperature was recorded during set and lift events.

LGLFRO recorded depths at several additional intervals (e.g. 2, 5, and 7 minutes) to determine the mean depth for each tow. Surface temperature, surface and bottom dissolved oxygen levels, and water transparency were also recorded at each location sampled in Lakes Erie and Ontario, (Table 4).

Catches of fish were sorted by species and counted, and the total length of up to 50 specimens of each species were measured to the nearest millimeter. All captured species were released, except aquatic invasive species (AIS) (i.e. ruffe, round goby, white perch, sea lamprey, tubenose goby (*Proterorhinus marmoratus*), threespine stickleback (*Gasterosteus aculeatus*), fourspine stickleback (*Apeltes quadracus*), common carp (*Cyprinus carpio*), rudd (*Scardinius erythrophthalmus*), rusty crayfish **(***Orconectes rusticus***),** zebra mussel (*Dreissena polymorpha*), quagga mussel (*Dreissena bugensis*), and Eurasian watermilfoil (*Myriophyllum spicatum*)). Captured AIS were either destroyed, preserved in 95% ethyl alcohol (EtOH), or frozen for later laboratory analysis. Specimens of unidentified species were retained for later identification.

For age determination, otoliths, the third dorsal spine, and a sample of scales were taken from each captured ruffe. Total length, weight, sex, and maturity were also recorded from individual ruffe specimens.

Public awareness of ruffe continued to be emphasized. Ruffe Watch cards and other information were distributed to harbor-masters, marinas, bait vendors, and motel managers, as well as cooperators and individual private citizens near sampling locations in the Great Lakes. Accomplishment reports, information for newsletter articles, and presentations were also conducted or provided.

Cooperation from agency partners and the public continued to expand the coverage and frequency of ruffe observations. Private anglers continued to report ruffe catches within the detected ruffe range, and some agencies and organizations reported fish sampling that was capable of incidental ruffe capture. Contributors included USFWS Sea Lamprey Control Offices, the USGS-Great Lakes Science Center, MIDNR, the Keweenaw Bay Indian Community, the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), Chippewa Ottawa Resource Authority (CORA), National Park Service (NPS), Lake Superior State University (LSSU), Dow Chemical-USA, Grand Traverse Band of Ottawa and Chippewa Indians (GTBOCI), and the Little Traverse Bay Band of Ottawa Indians (LTBBOI).

Canadian Waters of the Great Lakes

Ruffe surveillance in the Canadian waters of the Great Lakes is conducted only in Lake Superior. However, a variety of other fishery assessment work is ongoing in the remaining Great Lakes and tributaries that could detect the presence of ruffe. Also, public awareness programs encourage public reporting of ruffe and other invasive species sightings.

Ruffe surveillance in the Thunder Bay Harbour area of Lake Superior was conducted by the OMNR-Lake Superior Mgt. Unit and the USFWS-Ashland FRO. The method of ruffe surveillance was bottom trawling (4.9 m headrope), and is described within the prior section (U.S. waters of the Great Lakes). Bottom trawl tows of 5-minute duration were conducted at locations established by the LSMU in the Mission, McKellar and Kaministiquia Rivers, and in Thunder Bay Harbour.

Cooperation from numerous OMNR fishery offices and the public continued to expand the coverage and frequency of ruffe

observations.

In Lake Huron, OMNR conducted a recreational creel survey program, commercial catch sampling, a near-shore small fish assessment program, and community index programs consisting of 13 nearshore sites and 5 offshore sites.

Netting programs that were capable of capturing ruffe incidentally, used gill nets, trap nets, seines and hoop nets in locations throughout the lake and tributaries.

In Lake Erie and Lake St. Clair, fish sampling programs capable of detecting ruffe included habitat and population surveys, creel sampling, and commercial catch monitoring. Using electrofishing and seining, Fisheries and Oceans Canada conducted sampling for species richness and population monitoring (one project in conjunction with OMNR) in tributaries and bays of Lakes Erie and St. Clair.

In Lake Ontario, OMNR conducted an angler survey and population monitoring programs using trap nets and gill nets. Using electrofishing and seining, Fisheries and Oceans Canada conducted sampling in tributaries for species richness and population monitoring. All of these programs were capable of capturing ruffe incidentally.

OMNR has maintained an awareness program for ruffe and other exotic species in partnership with the Ontario Federation of Anglers and Hunters (OFAH) since 1992. Posters, fact sheets and Ruffe Watch ID packages were distributed at many events and meetings, and information was published on the internet at www.invadingspecies.com. A waterproof bait-bucket sticker featuring ruffe and three other invaders was also distributed throughout the province. The partnership also maintains a toll-free *Invading Species Hotline* (1-800-563-7711) that includes public access to information, and the ability to report sightings of ruffe and other invasive species.

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RESULTS

GREAT LAKES BASIN-CANADIAN WATERS

There were no confirmed ruffe reports from the public through the OMNR/OFAH partnership program.

LAKE SUPERIOR

Ruffe Surveillance in Canadian Waters, 2005

Thunder Bay Harbour, Ontario The OMNR-Lake Superior Mgt. Unit and the USFWS-Ashland FRO conduct a fall survey annually to monitor ruffe range expansion within the harbour, and assess abundance of ruffe and native species. A total of 25 bottom trawl transects are established, that includes the McKellar and Mission River's, and the lower reach of the Kaministiquia River, as well as the harbour proper (Figures 1, 2 and Table 1). Trawling was completed on 16 transects as far north as transect eight (Figure 2) for a total effort of 1.3 hours. Tows were not completed at transects one thru seven (north and central harbour) (Figure 2) due to encounters with bottom obstructions. A total of 3,065 fish were captured including 68 mature ruffe, 33 YOY ruffe, 10 threespine stickleback, and 16 fourspine stickleback. Ruffe comprised over 3% of the total catch, and were captured from sites where they were previously detected. The total catch consisted of 18 taxa, with ninespine stickleback (*Pungitius pungitius*) dominating (60%) the catch followed by rainbow smelt (*Osmerus mordax*) (27%), and trout-perch (*Percopsis omiscomaycus*) (6%). Ruffe were first detected here in 1991.

Ruffe Surveillance in U.S. Waters, 2005

On the periphery and outside of the detected ruffe range, the Ashland FRO conducted ruffe surveillance during spring and fall at 6 established locations. The surveys captured a total of five ruffe from previously detected peripheral locations (Keweenaw Waterway,

Michigan & Marquette Harbor, Michigan) (Figure 1). Due to slow expansion of ruffe and difficulty in conducting effective monitoring, no ruffe surveillance was conducted in Minnesota waters. A summary of fish species captured at dedicated locations is available upon request from the Ashland FRO.

Keweenaw Waterway, Michigan A total of 16 bottom trawls were completed over eight established transects in the southern half of the waterway (Figure 1 and Table 1). These transects are located in deep flats (5-8 m) and natural and dredged channels. In Pike Bay, a total of three mature ruffe (72, 123, & 129 mm TL) were captured during the spring survey, and one mature ruffe (124 mm TL) was captured during the fall survey. Ruffe were previously captured from the Pike Bay transects, and no ruffe were captured from other previous capture transects (Portage Lake south entry and Sturgeon River Sloughs). Seasonal species diversity consisted of 20 taxa from the spring survey and 15 taxa from the fall survey. Both surveys combined, the total catch consisted of 20 taxa, with spottail shiner (*Notropis hudsonius*) dominating the catch followed by trout-perch, and yellow perch. Ruffe were first detected in the waterway in 2002. No other AIS were captured.

Pequaming Bay, Michigan A total of 12 bottom trawls were completed over six established transects located in deep flats (3-7 m) and deep sloping substrate (8-15 m) (Figure 1 and Table 1). Seasonal species diversity consisted of nine taxa from the spring survey and 11 taxa from the fall survey. Both surveys combined, the total catch consisted of 13 taxa, with ninespine stickleback dominating the catch followed by mottled sculpin (*Cottus bairdi*) and slimy sculpin (*Cottus cognatus*). A total of two invasive threespine stickleback were captured during the spring survey. No ruffe or other AIS were captured.

Western Pequaming Bay contains potential ruffe habitat that is untrawlable due to the presence of fish cribs; this area was sampled with modified Windermere traps in seven locations consisting of sand and rock substrate (Figure 1 and Table 1). Seasonal species diversity consisted of two taxa during each of the spring/fall surveys. Both seasons combined, the total catch consisted of three taxa, with white sucker (*Catostomus commersoni*), dominating the total catch followed by burbot (*Lota lota*), and mottled sculpin. White sucker was captured only during the fall survey. No ruffe or other AIS were captured.

Marquette Harbor, Michigan A total of ten bottom trawls were completed over five established transects located adjacent to cargo vessel docks (Figure 1 and Table 1). Seasonal species diversity consisted of eight taxa during the spring survey and ten taxa during the fall survey. Both seasons combined, the total catch consisted of 13 taxa, including ruffe. A single mature ruffe (102 mm TL) was captured from the same lower harbor transect and during the same season (fall), as the initial discovery in 2004. Brook stickleback (*Culaea inconstans*) dominated the total catch followed by mottled sculpin and ninespine stickleback. A total of six threespine stickleback were collected from the lower harbor during the spring survey. Threespine stickleback were previously detected here.

Munising Bay, Michigan A total of six bottom trawls were completed over three established transects located adjacent to a cargo vessel dock, river entry, and along a steep shelf at the 7-8 meter contour level (Figure 1 and Table 1). Seasonal species diversity consisted of five taxa during both spring and fall surveys. Both seasons combined, the total catch consisted of seven taxa, with mottled sculpin dominating the total catch. No ruffe or other AIS were captured.

Some of the potential ruffe habitat in Munising Bay is untrawlable due to the presence of fish cribs and a dense bed of macrophytes; these sites were sampled with modified Windermere traps in seven locations and a mini fyke net in one location. Seasonal species diversity consisted of two taxa during the spring survey and six taxa during the fall survey. Both seasons combined, the total catch consisted of seven taxa, with mottled sculpin dominating the total catch. No ruffe or other AIS were captured.

Grand Marais, Michigan (West Bay) A total of eight bottom trawls were completed over four established transects located in deep sand flats (10-14 m) and a dredged channel (Figure 1 and Table 1). Seasonal species diversity consisted of 10 taxa during the spring survey and 12 taxa during the fall survey. Both seasons combined, the total catch consisted of 14 taxa, with trout-perch dominating the total catch followed by spottail shiner and yellow perch. A total of eight threespine stickleback were captured during the spring survey. No ruffe or other AIS were captured.

Tahquamenon River, Michigan (above estuary) A total of ten bottom trawls were completed over six established transects located in natural channels and pools in the lower reach (3 km upriver from the mouth) of the river (Figure 1 and Table 1). During the fall survey, two of the transects were untrawlable due to the presence of logs. Seasonal species diversity consisted of eight taxa during both spring/fall surveys. Both seasons combined, a total of ten taxa were captured, with spottail shiner dominating the total catch followed by trout-perch and mimic shiner (*Notropis volucellus*). No ruffe or other AIS were captured.

The Tahquamenon River Estuary consists of ruffe habitat, that is untrawlable due to the presence of numerous stumps and logs. During the spring survey, the estuary was sampled with modified Windermere traps in six locations. During the fall survey, the estuary was sampled with modified Windermere traps in three locations and mini fyke nets in three locations. During both seasons combined, a total of 12 species were captured in all trap nets with rock bass (*Ambloplites rupestris*) and yellow perch dominating the total catch followed by white sucker. The majority of the yellow perch were YOY, and were captured in the mini fyke nets. The total catch from the spring survey (Windermeres only) consisted of two taxa, rock bass and spottail shiner. Species diversity by gear type consisted of 6 taxa captured in the modified Windermere traps and 11 taxa captured in the mini fyke nets. No ruffe or other AIS were captured.

Reported Fish Sampling That was Capable of Capturing Ruffe Incidentally

The USFWS, USGS, MIDNR, GLIFWC, and the Keweenaw Bay Tribal Natural Resources Department (KBTNRD) reported fish sampling in 84 locations that was capable of capturing ruffe incidentally (Figures 1, 3, 4, and Table 1). This sampling captured a total of two ruffe in two new locations near the periphery of the ruffe range, confirming minor range expansion.

Nearshore/Offshore USGS-Lake Superior Biological Station conducted bottom trawling (11.9m headrope) to assess spring fish community abundance. Near the periphery and outside of the detected ruffe range, transects included 54 stations spanning the nearshore around the lake, and 6 offshore stations. (Figure 3 and Table 1). The three most abundant species collected were rainbow smelt, bloater (*Coregonus hoyi*), and lake herring (*Coregonus artedii*). No ruffe were captured at these stations. A total of seven ruffe were captured at nearshore stations within the detected ruffe range.

USGS-Lake Superior Biological Station conducted bottom trawling in conjunction with an acoustic assessment of spawning lake herring in Thunder Bay, Ontario. The trawling occurred in November, 5 km northeast of Thunder Bay Harbour at a depth range of 23-29 m (Figure 4 and Table 1). One YOY ruffe (69 mm total length (TL)) was captured, the first ruffe to be confirmed along the north shore, east of Thunder Bay Harbour. In reference to the tow that captured the ruffe, the three most abundant species collected were ninespine stickleback, rainbow smelt, and spoonhead sculpin (*Cottus ricei*).

Keweenaw Waterway, Michigan MIDNR reported one mature ruffe (145 mm TL) captured from Torch Lake in September (Figure 4 and Table 1). Torch Lake is located 10 km off the waterway proper, but is connected to the waterway by the Torch Lake Canal. The specimen was an adult female with developing eggs, and was caught by hook and line.

South Shore Tributaries MBS, GLIFWC, NPS, and private contractors conducted trapping in seven south shore tributaries east of the detected ruffe range to assess sea lamprey abundance (Figure 4 and Table 1). No ruffe were captured in these tributaries. A total of 27 ruffe were captured in tributaries within the detected ruffe range, including one ruffe from the Misery River, 35 km south of the north entry to the Keweenaw Waterway, Michigan (Figure 4). Ruffe were first detected in the Misery River in 2004. A summary of fish species captured in these surveys is archived at MBS.

Keweenaw Bay, Michigan The KBTNRD conducted fish assessments in lower Keweenaw Bay using 50 and 63 mm stretch mesh gill nets. The tribe also conducted backpack electrofishing in two lower bay tributaries. The tribe and Ashland FRO conducted nearshore boom electrofishing that included 20 km of total effort (Figure 4 and Table 1). No ruffe were captured.

Huron Bay, Michigan The Ashland FRO and KBTNRD conducted nearshore boom electrofishing that included 20 km of total effort (Figure 4 and Table 1). No ruffe were captured.

Isle Royale During June and September, the Ashland FRO conducted assessments in eight locations using fyke nets and electrofishing (Figure 4 and Table 1). No ruffe were captured.

Vicinity of Pictured Rocks National Lakeshore, Michigan During late August, MIDNR conducted a lake trout assessment at four locations using gill nets (Figure 4 and Table 1). The 91 meter long panels consisted of 50, 56, 63, and 69 mm stretch mesh. No ruffe were captured.

Southeastern Lake Superior Ashland FRO conducted a lake whitefish assessment at four locations east of Grand Marais, Michigan (Figure 4 and Table 1). The survey was conducted with gill nets during July. The 30.5 meter long panels consisted of 50, 56, and 63

mm stretch mesh. Six taxa were captured in these three mesh sizes with fat lake trout (*Salvelinus namaycush siscowet*) dominating the total catch followed by round whitefish (*Prosopium cylindraceum*) and lake herring. No ruffe were captured.

Unconfirmed Sightings None reported.

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LAKE MICHIGAN

No ruffe surveillance was conducted. The USFWS, USGS, MIDNR, and tribal communities reported other fish sampling in 24 locations, that was capable of incidental ruffe capture.

MIDNR captured a total of 22 ruffe from Little Bay de Noc, a location where ruffe had been previously detected (Figures 1, 4, and Table 2).

Reported Fish Sampling That was Capable of Capturing Ruffe Incidentally

Nearshore/Offshore USGS-Great Lakes Science Center conducted fall bottom trawling (12 m headrope) on contour to assess prey fish community abundance. Outside and near the periphery of the detected ruffe range (Bays de Noc), transects included seven locations around the lake. (Figure 5 and Table 2). A total of 70 tows were completed comprising 11.7 hours of effort. The four most abundant species captured were ninespine stickleback, deepwater sculpin (*Myoxocephalus quadricornis*), slimy sculpin, and rainbow smelt. Invasive fish captured included totals of 37 round goby and 32 threespine stickleback. No ruffe were captured.

Little Bay de Noc (LBDN) From 2004-2010, MIDNR is conducting fall assessments to determine the relative contribution of hatchery-raised walleye (*Stizostedian vitreum*) to year classes of walleye stocks. Each year, a random subset of transects are sampled from a larger set of established transects. The gear includes 25, 38, and 50 mm stretch mesh gill nets, and boom electrofishing (Figures 4, 6, 7, and Table 2). In 2005, a total of eight transects were electrofished, and four transects were gill netted. A total of 20 mature ruffe were captured in gill nets. Ruffe were first detected here in 2002.

Since 1988, MIDNR has been conducting summer assessments in LBDN using trawls and experimental gill nets. In 2005, a total of 50 minutes bottom trawling and two gill net nights were completed. A total of one YOY ruffe was captured in trawls, and one mature ruffe was captured in gill nets (Figure 4 and Table 2).

Big Bay de Noc (BBDN) From 2004-2010, MIDNR is conducting the same fall walleye assessment in BBDN as in LBDN (described in LBDN). In 2005, a total of 6 transects were electrofished, and 12 transects were gill netted (Figures 4, 6, 7 and Table 2). No ruffe were captured. Ruffe were first detected here in 2004.

Since 1988, MIDNR has been conducting summer assessments in BBDN similar to LBDN (described in LBDN). In 2005, a total of 50 minutes bottom trawling and two gill net nights were completed (Figure 4 and Table 2). No ruffe were captured.

Tributaries Marquette and Ludington Biological Stations in cooperation with the Grand Traverse Band of Ottawa and Chippewa Indians, the Little Traverse Bay Band of Ottawa Indians, and private contractors conducted trapping in 15 tributaries to assess sea lamprey abundance (Figure 4 and Table 2). A summary of fish species captured at these locations is available upon request from MBS. No ruffe were captured.

Unconfirmed Sightings None reported.

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LAKE HURON

Alpena FRO conducted ruffe population reduction to remove spring spawning ruffe from the Thunder Bay River, Michigan, and fall ruffe surveillance at ten locations in U.S. waters. MBS and USGS reported other fish sampling at 19 locations, that was capable of incidental ruffe capture. No ruffe were captured from Lake Huron or the St. Marys River.

Ruffe Population Reduction during 2005

Thunder Bay River During April and May, the Alpena FRO conducted a concentrated effort (90 gill net nights) to remove spawning phase adult ruffe from this tributary with small mesh gill nets (Figure 1 and Table 3). This annual effort was initiated in 2002. The ruffe reduction targeted deep channels adjacent to shallow areas where ruffe had been previously captured. No ruffe were captured.

Alpena FRO also set small mesh gill nets during fall for comparison to spring removal efforts (Table 3). No ruffe were captured. Ruffe were first detected here in 1995.

West Shore Transects & St. Marys River During September and October, Alpena FRO conducted ruffe surveillance at ten established locations in U.S. waters of Lake Huron and the St. Marys River (Figure 1 and Table 3). Using a small mesh bottom trawl, the surveys targeted deep water shipping channels and river mouths. No ruffe were captured from the Thunder Bay area or any other location. Round goby was the most abundant species captured from the Thunder Bay River and Thunder Bay, and comprised 97 percent of the total catch.

The total catch from fall ruffe surveillance consisted of 24 taxa. Alewife (*Alosa pseudoharengus*) and trout-perch were the most abundant species captured overall (23 % of the total catch) followed by round goby (15 % of the total catch). Round goby were captured at five previously detected locations; they were the most abundant species at four of the locations, and second in abundance at the remaining location. No round goby were captrued from the St. Marys River where species diversity of fish was highest. De Tour Passage and Baie de Wasai had the greatest diversity (12 and 13 taxa respectively), and the highest total catch of fish occurred at De Tour Passage. A summary of fish species captured in all locations is available upon request from the Alpena FRO.

Reported Fish Sampling That was Capable of Capturing Ruffe Incidentally

Nearshore/Offshore USGS-Great Lakes Science Center conducted fall bottom trawling (21 m wing trawl) on contour to assess the status and trends of the Lake Huron deepwater fish community. A total of 43 tows were completed, comprising 7.2 hours of effort over five U.S. locations and one Canadian location (Figure 8 and Table 3). The three most abundant species captured were rainbow smelt, bloater, and YOY alewife.

However, the report suggested that the high abundance of alewife was likely due to spillover from a strong year class in Lake Michigan. Round goby captures indicated a mean density of 42/ha, down from a peak of 131/ha in 2003. No ruffe were captured.

MBS, in cooperation with CORA, Dow Chemical-USA, LSSU, and private contractors, conducted trapping in 12 tributaries and the St Marys River to assess sea lamprey abundance (Figure 4 and Table 3). No ruffe were captured. A summary of fish species captured at these locations is available upon request from MBS.

In Canadian waters, OMNR reported over 184,000 fish were sampled, including 778 round goby. No ruffe were captured.

Unconfirmed Sightings A tribal commercial fisherman reported catching a ruffe near Kettle Point, Ontario. However, the fisherman did not present the specimen to OMNR for verification. OMNR suspects that the specimen was likely a white perch, since white perch are known to occur in the vicinity of Kettle Point.

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LAKE ERIE

The Lower Great Lakes FRO conducted ruffe surveillance during spring and fall at seven established locations in U.S. waters. MBS and USGS reported other fish sampling that was capable of incidental ruffe capture in four locations. No ruffe were captured.

Ruffe Surveillance during 2005

The Lower Great Lakes FRO completed ruffe surveillance at seven previously established locations including Sandusky, Toledo, Cleveland, Ashtabula, and Conneaut, Ohio, Erie, Pennsylvania, and Buffalo, New York. The survey gear was a bottom trawl with a 4.9 m headrope. All sites were sampled once during spring (May) and once during fall (September/October) (Figure 9 and Table 4). The total catch from the spring survey consisted of 11 taxa, and the majority of the catch consisted of emerald shiner (*Notropis atherinoides*) (29%), spottail shiner (19%), and channel catfish (*Ictalurus punctatus*) (17%). The total catch from the fall survey consisted of 16 taxa, and the majority of the catch consisted of white perch (30%), emerald shiner (21%), channel catfish (12%), and rainbow smelt (12%). A summary of fish species captured at these locations is available upon request from the LGLFRO.

Reported Fish Sampling That was Capable of Capturing Ruffe Incidentally

South Shore Tributaries MBS and private contractors conducted trapping in three tributaries to assess sea lamprey abundance (Figure 10 and Table 4). No ruffe were captured. A summary of fish species captured at these locations is available upon request from MBS.

Nearshore/Offshore USGS-Lake Erie Biological Station completed two seasonal (summer-fall) bottom trawl (7.9 m headrope) surveys in U.S. waters to assess the status of fish stocks in western Lake Erie. These surveys were conducted near East Harbor State Park, OH, and consisted of 72 tows on contour for a total effort of 12 hours (Figure 10 and Table 4). During the fall survey, the most abundant species (> age 0) captured was white perch (16/ha) followed by spottail shiner (13/ha), and round goby (11/ha). No ruffe were captured.

In Canadian waters, OMNR reported over 70,000 fish were sampled, including many round goby. No ruffe were captured.

Unconfirmed Sightings None reported.

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LAKE ONTARIO

The Lower Great Lakes FRO conducted ruffe surveillance during spring and fall at one established location. MBS and USGS reported other fish sampling that was capable of incidental ruffe capture in 15 locations. No ruffe were captured.

Ruffe Surveillance during 2005

Genessee River/Rochester Harbor During May and October, the LGLFRO conducted bottom trawling in established transects located within the dredged shipping channel, approximately 3 km upstream from the lake (Figure 9 and Table 4). During the spring survey, the total catch consisted of five taxa including, alewife (*Alosa pseudoharengus*) (72%), emerald shiner (20%), spottail shiner (4%), johnny darter (*Ethiostoma nigrum*) (2%), and shorthead redhorse (*Moxostoma macrolepidotum)* (2%). During the fall survey, the total catch also consisted of five taxa including, common shiner (*Notropis cornutus*) (69%), spottail shiner (22%), alewife (4%), trout-perch (4%), and round goby (2%).

Reported Fish Sampling That was Capable of Capturing Ruffe Incidentally

South Shore Tributaries MBS contracted with private contractors to conduct trapping in three tributaries to assess sea lamprey abundance (Figure 10 and Table 4). No ruffe were captured. A summary of fish species captured at these locations is available upon request from MBS.

Nearshore/Offshore USGS-Lake Ontario Biological Station and the New York State Department of Environmental Conservation (NYSDEC) conducted three seasonal (spring, summer, fall) bottom trawl surveys in U.S. waters to assess the status of major prey fish stocks. These surveys sampled 12 established transects along the south shore (Figure 11 and Table 4). A total of 263 tows (approximately 44 hours effort) were completed over all seasons within the transects. The three most abundant species collected were alewife, rainbow smelt, and slimy sculpin. No ruffe were captured.

In Canadian waters, OMNR reported thousands of fish were sampled, including many round goby. No ruffe were captured.

Unconfirmed Sightings None reported.

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DISCUSSION

LAKE SUPERIOR

Thunder Bay Harbour, Ontario Since northern and central Thunder Bay harbour (transects 1-7) were not sampled, ruffe range expansion cannot be confirmed outside of their detected range (transects 7-31) within the harbour (Figure 2). Trawl transects were only completed south of transect seven, which lie within the detected ruffe range. However, with the capture of one YOY ruffe five km northeast of the harbour, the presence of ruffe in the northern harbour is likely. In addition, OMNR has received angler reports of ruffe caught near the mouth of the Current River, which is located at the north end of the harbour (Figure 2).

Within the detected ruffe range, the majority of age 0-1 ruffe were captured from the headwaters of the McKellar River (transect 17), where it departs from the Kaministiquia (Kam) River (Figure 2). The majority of age 2+ ruffe were captured from the Kam River (transect 31) and the headwaters of the Mission River (transect 21), where it departs from the Kam River (Figure 2). The largest catch (39) of adult ruffe was collected from transect 31.

The distribution of ruffe within Thunder Bay harbour may be due in part to two variables, bottom temperature and the level of light intensity in the water. Bottom temperatures for the tributary transects 17, 31, and 21 (majority of the total ruffe catch) were 14.7, 17.1, and 11.3 ˚ C respectively. The difference in average bottom temperatures between these tributary transects (14.4 ˚ C) and the harbour transects (11.5 ˚ C) is nearly 3 ˚ C. The warmer tributary waters may in part suggest an attraction for ruffe. Another factor that may in part suggest ruffe attraction for the tributaries is water clarity. Ruffe are known to prefer waters with a low level of light intensity, and the level of light intensity is directly related to water clarity. Generally, the tributary transects have a lower water clarity (secchi range <2 m) than the harbour transects (secchi range >2 m).

The ruffe CPE in trawls has declined in Thunder Bay harbour ruffe surveillance, from a high of 569/hour in 2003 to 81/hour in 2005. However, there is evidence to suggest that the decline in the ruffe CPE may not be reflective of overall ruffe abundance in the harbour area, but rather a change in distribution due to seasonal behavior. During September, 2005, a preliminary 3-day survey to assess the feasibility of ruffe population reduction in the area of transect 31 (Kam River) captured a total of nearly 5,000 adult ruffe (Figure 2). The average ruffe CPE was 1,166/hour in trawls. In addition, ruffe surveillance history has identified a behavior in which resident river ruffe appear to congregate in the vicinity of river estuaries for a short period in the fall. This behavior is likely triggered at least in part by the change in water temperature. Ruffe surveillance history has also indicated that the duration of this ruffe congregation is relatively short (approximately 2-3 weeks). Ruffe surveillance from 2003-2005 has been conducted from mid-September to mid-October; therefore, it is likely that this behavior is responsible for some of the variability in the ruffe CPE. However, the total ruffe catch from the reduction feasibility survey suggests that a very large ruffe spawning population exists in the Kam River, the major harbour tributary.

Keweenaw Waterway, Michigan Ruffe continue to spread within the Keweenaw Waterway (KW). In 2002, ruffe were initially discovered in the Sturgeon River Sloughs. In 2004, ruffe were detected in the south entry to Portage Lake, one of three transects in Pike Bay, and the north entry to Portage Lake. These sites are located 1.5, 6, and 10 km respectively from the Sturgeon River Sloughs. In 2005, ruffe were detected in two additional transects within Pike Bay, as well as Torch Lake. Torch Lake is 10 km from

Portage Lake, and is connected to Portage Lake by Torch Bay and the Torch Lake Canal. In addition, the total catch of ruffe on the dedicated established transects has increased from one in 2002, to three in 2004, to four in 2005. The absence of YOY ruffe in the fall KW catches is not unusual. Ruffe population investigation surveys in Wisconsin/Michigan tributaries suggest that most YOY ruffe occupy tributary estuaries, while WIDNR gill net catches suggest that a significant portion of adult ruffe (age 2+) occupy the deeper waters of embayments and the nearshore lake proper. Except for the Sturgeon River Slough transect, the KW transects are located in deep dredged channels, near lake entries, and within an embayment.

Marquette Harbor, Michigan With the capture of one yearling ruffe from Marquette harbor in 2005, and one YOY ruffe in 2004, the size and status of the ruffe colony there is still unclear. Both ruffe were captured from the same transect (heavy boat slip) and the same time of year (fall). The evidence suggests that some reproduction may be occurring, but for the second year in a row, no spawning adult ruffe were captured during the spring survey. Continued ruffe surveillance with additional trawls and gear will be needed to assess the status of ruffe there.

Tahquamenon River Estuary, Michigan The dominating spring/fall catch (85/88%) of rock bass and low species diversity (2/5 taxa) in the modified Windermere traps suggested that the strong presence of rock bass in the holding chamber of the traps may have biased the catch results in these traps. Rock bass are known to be aggressive predators, and the close proximity of the holding chamber to the entrances of the traps may have repelled other taxa from entering the traps. To circumvent the possibility that ruffe may also be repelled by a large, concentrated collection of rock bass, the Ashland FRO supplemented the fall estuary sampling with mini fyke nets. The mini fyke nets are attached to a 15 meter lead net at the trap entrance, and the entrance is over one meter distance from the holding chamber. The species diversity (11 taxa) of the total fyke net catch compared to that (5 taxa) of the Windermere traps suggests that captured rock bass may be in part decreasing the capture ability of the modified Windermere traps.

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LAKE HURON

Ruffe have not been discovered in the St. Marys River and were not captured from the Thunder Bay River or discovered at any other locations within Lake Huron in 2005. No ruffe have been captured from Lake Huron for the past two years and were last captured in the spring of 2003.

Thunder Bay, Michigan Within the Thunder Bay area, the absence of YOY ruffe from fall ruffe surveillance trawling from 2001 to present, and the decline in spring adult spawning ruffe captured in gill nets from 2002 to 2003 followed by the absence of ruffe in 2004 and 2005 suggests an overall decline in the Lake Huron ruffe population. The absence of YOY was an initial sign that recruitment may not be taking place, and the more recent decline and absence of spawning adults also suggests that any recruitment was insufficient to foster the population. It is unknown why the large abundance of ruffe captured in 1999 (470 ruffe), an 11 fold increase in abundance over the 1998 catch, did not transfer into a large catch of adult or subsequent YOY in 2000. One reason may be the colonization and subsequent flourishing of the round goby in the Thunder Bay area. The round goby was first captured from the Thunder Bay River in 1999, and although their abundance was low that year (14% of total catch), they became the most abundant species captured from the river the following year, a status which has continued. Round goby are known egg feeders, can spawn multiple times in a season, guard their nests to ensure the development of their young, and are very aggressive. Although direct interactions are unknown between goby and ruffe, we surmise that goby may be feeding on ruffe eggs and/or young that were deposited and/or hatched in the river in the spring and early summer, or that goby may be having some other negative effect on ruffe. Following 2001, ruffe were not captured from the Thunder Bay River or adjacent waters in fall trawling surveys, however, round goby were the most abundant species captured from these waters during fall trawling surveys conducted through 2002 and in 2004 and 2005.

Although YOY ruffe have not been captured from the Thunder Bay River in the fall since 2001, adult spawning phase ruffe were captured from the river through spring, 2003. Alpena FRO initiated a spring reduction effort in 2002 to remove adult spawning ruffe prior to reproduction using gill nets. The catch of adults declined from 2002 (96 ruffe) to 2003 (10 ruffe) and no ruffe were captured in 2004 or 2005. It may be that the removal of spawning adults, coupled with other events, possibly predation effects of round goby, may be contributing to the decline in ruffe numbers.

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LAKE MICHIGAN

Bays de Noc Although the MIDNR assessment did not capture ruffe in Big Bay de Noc (BBDN), the catch of 22 ruffe in neighboring Little Bay de Noc (LBDN) is the largest confirmed catch since ruffe were detected there in 2002. In reference to BBDN, the history of ruffe range expansion suggests that during their early years of invasion, captures can vary with regard to total number and location. The MIDNR fish sampling suggests that ruffe recruitment is occurring, and ruffe abundance is continuing to increase in northern LBDN. Reported ruffe captures in LBDN from 2002-2005 totaled 3, 4, 3, and 22 respectively. Although sampling gear and effort has not been consistent through all ruffe capture years, the sampling design and gear used in the MIDNR walleye study (2004-2010) has the potential to provide consistency and reliability in reference to incidental monitoring of ruffe in BBDN as well as in LBDN (Figures 6 and 7). The sampling is random, and the gill net mesh size (25, 38, and 50 mm stretch mesh) is ideal for capturing adult ruffe.

Based on the events in the Thunder Bay River, Lake Huron, it may be that the presence of round goby might have some effect on ruffe abundance in LBDN, but currently there are no observable trends. However, the size of the ruffe range and the complexity of habitat in LBDN compared to the Thunder Bay River is significantly greater, and the ruffe may be occupying niches where the goby is not a threat. Ruffe abundance versus round goby abundance in LBDN deserves monitoring.

How Successfully Is Ruffe Range Expansion Being Delayed in the Great Lakes?

The U.S. Geological Survey projected future unassisted range expansion of ruffe based on lake currents and U.S. documented ruffe range expansion through 1994 (unpublished, USGS, Great Lakes Science Center, Lake Superior Biological Station). In Lake Superior, USGS projected 2002 as the most likely year of ruffe arrival in the Keweenaw Waterway, MI, and 2006 as the most likely year of ruffe arrival in Marquette, MI. Documented arrival of ruffe in the Keweenaw Waterway was 2002, and Marquette was 2004. In Lake Huron, the most likely year of ruffe arrival in Saginaw Bay was projected to be 2003. Ruffe surveillance has not documented the presence of ruffe in Saginaw Bay, or any other location in Lake Huron other than Thunder Bay near Alpena, 93 km north of Saginaw Bay. In Lake Michigan, ruffe were projected to likely arrive in Manistique, Michigan by 2007. Ruffe were documented to arrive in Big Bay de Noc in 2004, 50 km southwest of Manistique. Voluntary ballast exchange conducted by the Lake Carriers Association, educational efforts conducted by Sea Grant and state, tribal, and federal environmental organizations, and early detection of range expansion by ruffe surveillance and other fish sampling, have reduced the potential of human assisted ruffe range expansion. It appears that ruffe are continuing to expand their range unassisted by human activities at a rate very close to USGS projections.

Range of Ruffe

The current range of ruffe in the Great Lakes is as follows (See range map, last page):

Lake Superior

North Shore: From the Duluth/Superior Harbor, Minnesota/Wisconsin, USA, to 5 km northeast of the Current River, Thunder Bay Harbour, Ontario, Canada.

South Shore: From the Duluth/Superior Harbor, Minnesota/Wisconsin, to Marquette Harbor, Michigan.

Lake Huron

Thunder Bay River & Thunder Bay Shipping Channel near Alpena, MI.

Lake Michigan

Little Bay de Noc and Big Bay de Noc of Green Bay.

Lake Erie Lake Ontario Great Lakes Basin Inland Lakes & Streams

Unconfirmed. Undetected. Undetected.

Proposed Ruffe Surveillance and Ruffe Population Reduction in 2006

Lake Superior

Ashland FRO will continue to conduct ruffe surveillance to detect range expansion, age and/or size composition and changes in fish community near the periphery and outside of the documented ruffe range along the south shore of Lake Superior and in Thunder Bay Harbour, Ontario. Ruffe Surveillance is scheduled for spring and fall in the same locations as 2005. Within the periphery of the currently known range for ruffe along the south shore of Lake Superior, the locations include southern Keweenaw Waterway, Pequaming Bay, and Marquette Harbor, Michigan. Outside of the currently known range for ruffe, the locations include Munising Bay, Grand Marais (West Bay), and the Tahquamenon River (lower reach), Michigan, a tributary in western Whitefish Bay.

We will explore the feasibility of increasing effort in lower Marquette harbor to more accurately assess the status of the ruffe population first documented there in 2004.

We will again explore the feasibility of conducting a ruffe population reduction experiment in the Kaministiquia River, Ontario after consultation with the OMNR-Lake Superior Mgt. Unit.

Lake Michigan

No ruffe surveillance is scheduled due to lack of funding.

Lake Huron

Although ruffe were not captured from the Thunder Bay area in 2005, spring removal will continue in the Thunder Bay River. Fall ruffe surveillance will continue in nearshore areas, tributaries, and ports susceptible to ruffe invasion and the St. Marys River as well.

Lakes Erie and Ontario

LGLFRO plans to continue ruffe surveillance in dredged channels adjacent to harbors in U.S. waters of Lakes Erie and Ontario. These surveys will be conducted at Toledo, Sandusky, Cleveland, Ashtabula, Conneaut, Ohio; Erie, Pennsylvania; and Buffalo, New York, in Lake Erie; and the Genessee River (near Rochester, New York) in Lake Ontario. LGLFRO will continue to respond to angler reports of ruffe sightings.

Ruffe surveillance in additional waterways will be conducted as considered appropriate (e.g. to follow-up unconfirmed sightings and/or new reported discoveries).

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M. Mlynarek (USFWS-Whittlesey Cr. NWR) Patrick Herbert (Volunteer-LGLFRO)

Emily Zollweg (USFWS-LGLFRO) Mike Abrahmo (Volunteer-LGLFRO)

Betsy Trometer (USFWS-LGLFRO) Jennifer Tait (Volunteer-LGLFRO)

Chris Castiglione (USFWS-LGLFRO) Brad Conrad (Volunteer-LGLFRO)

Cara Ewell-Hodkin (USFWS-LGLFRO)

Reported Information From Other Fish Sampling Capable of Capturing Ruffe Incidentally

Mary Henson (USFWS-Marquette Biol. Stn.)

Troy Zorn (MIDNR)

Gary Cholwek (USGS-Lake Superior Biol. Stn.)

Phillip Schneeberger (MIDNR)

Lori Evrard (USGS-Lake Superior Biol. Stn.)

Gene Mensch (Keweenaw Bay Tribal Nat. Res.)

Jeff Schaeffer (USGS-Great Lakes Science Ctr.)

Charles Madenjian (USGS-Great Lakes Science Ctr.)

Michael Bur (USGS-Lake Erie Biol. Stn.)

Robert O'Gorman (USGS-Lake Ontario Biol. Stn.)

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Dawn Sucee (Ontario Federation of Anglers & Hunters

Brian Locke (OMNR-Lake Erie Mgt. Unit)

Lloyd Mohr (OMNR-Upper Great Lakes Mgt. Unit)

Scott Reid (OMNR-Biodiversity Section)

Nicholas E. Mandrak (Fisheries & Oceans Canada)

Ken Cullis (OMNR-Lake Superior Mgt. Unit)

Ted Schaner (OMNR-Lake Ontario Mgt. Unit)

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SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Figure 1. Dedicated locations surveyed for ruffe in the Upper Great Lakes, 2005.

1. Thunder Bay Harbour *	7. West Bay (Grand Marais)	13. Thunder Bay (River Ship. Channel)
2. Keweenaw Waterway *	8. Tahquamenon River	14. St. Marys River (De Tour Passage)
3. Pequaming Bay	9. Port Dolomite	15. St. Marys River (South Sugar Island Ferry)
4. Upper Marquette Harbor	10. Cheboygan River	16. St. Marys River (Baie de Wasi)
5. Lower Marquette Harbor *	11. Thunder Bay (LaFarge)	17. St. Marys River (SSM Municipal Harbor)
6. Munising Bay	12. Thunder Bay River	18. St. Marys River (Above Locks)

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Figure 2. Dedicated locations surveyed for ruffe in Thunder Bay Harbour, Ontario, 2005.

* Locations where ruffe were captured.

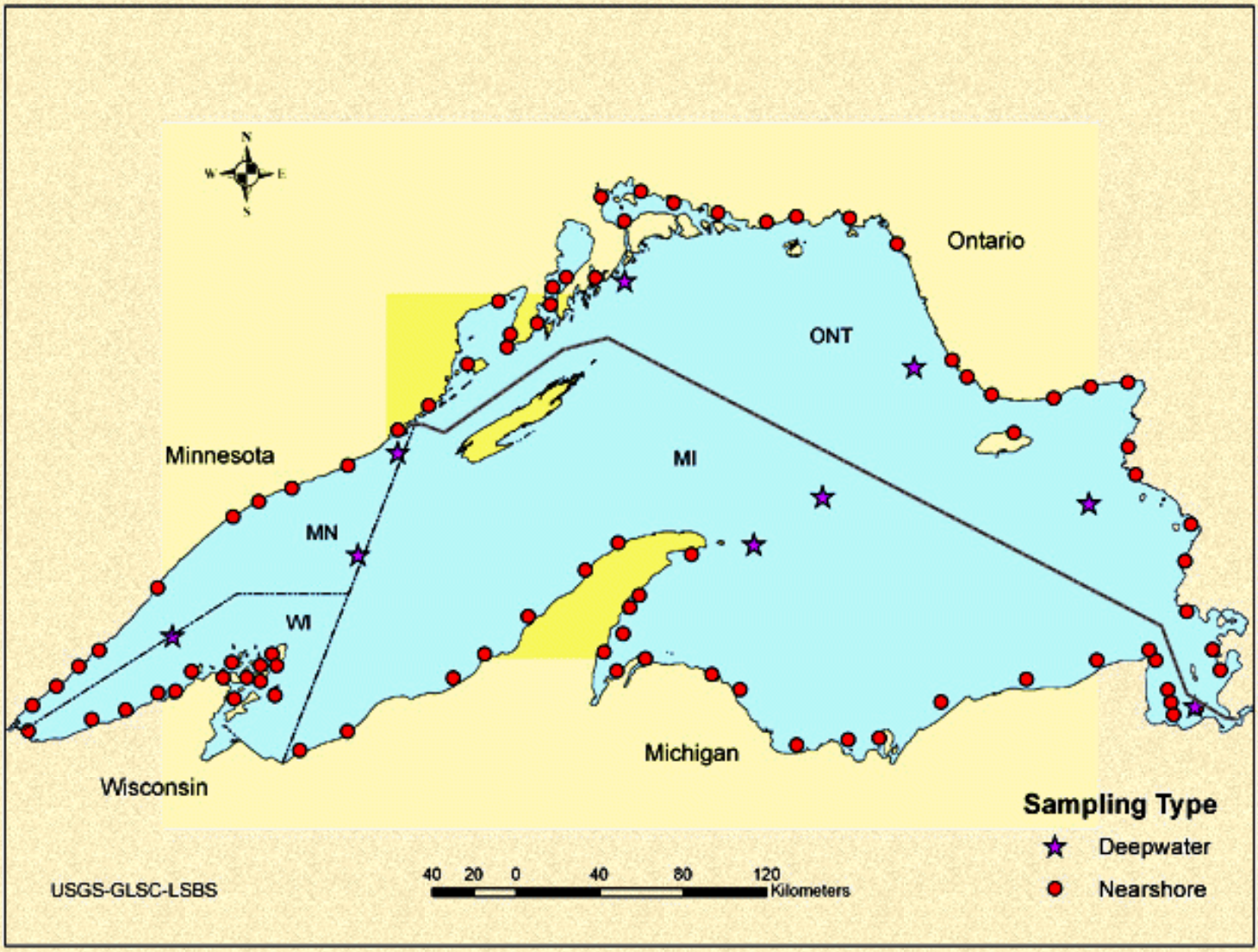
Ontario

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

USGS
science for a changing world

Great Lakes Science Center - Lake Superior Biological Stn.

Figure 3. USGS bottom trawling locations in Lake Superior, where ruffe were capable of incidental capture, 2005.


N
W
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Ontario
ONT
Minnesota
MI
MN
WI
Michigan
Wisconsin
Sampling Type
Deepwater
Nearshore
USGS-GLSC-LSBS
40 20 0 40 80 120
Kilometers

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Figure 4. Reported monitoring locations in the Upper Great Lakes, where ruffe were capable of incidental capture, 2005.

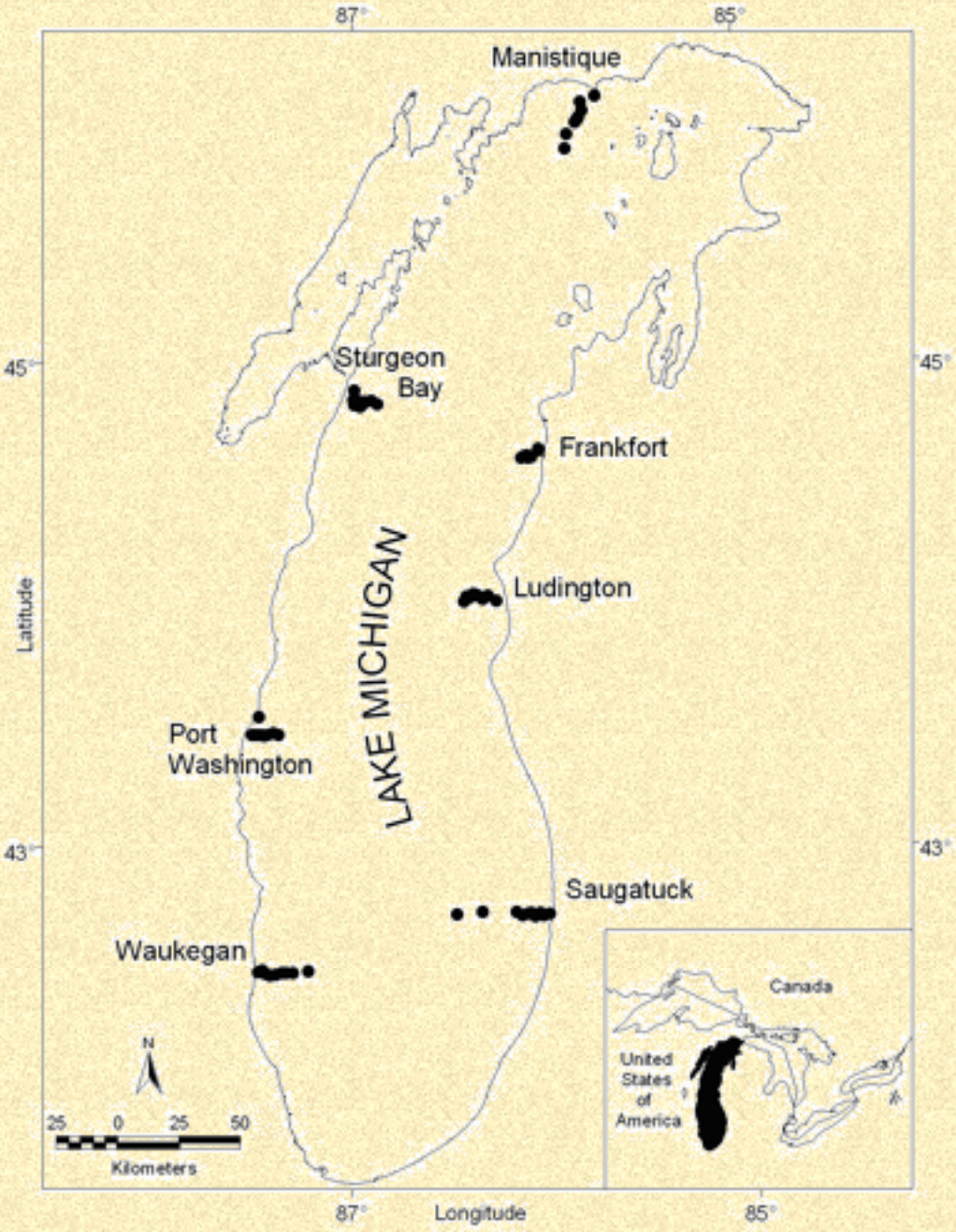
1. Misery River *
2. Torch Lake * *
3. Keweenaw Bay
4. Kelsey Creek
5. Little Silver Creek
6. Silver River
7. Huron Bay
8. Big Garlic River
9. Rock River
10. Furnace Creek
11. Miners River
12. Grand Portal-In
13. Grand Portal-Out
14. Ausable Point
15. Grand Marais
16. Perry's Landing
17. Blind Sucker
18. Deer Park
19. Betsy River
20. Tahquamenon River
21. Isle Royale
22. Thunder Bay * *
23. Hog Island Creek
24. Manistique River
25. Ogontz River
26. Big Bay de Noc
27. Little Bay de Noc *
28. Menominee River
29. Peshtigo River
30. Oconto River
31. St. Joseph River
32. Pere Marquette River
33. Little Manistee River
34. Big Manistee River
35. Betsie River
36. Boardman River
37. Deer Creek
38. Jordan River
39. Carp Lake Outlet
40. Carp River
41. St. Marys River
42. Albany Creek
43. Trout Creek
44. Nunns Creek
45. Cheboygan River
46. Greene Creek
47. Ocqueoc River
48. Trout River
49. Devils River
50. AuSable River
51. East AuGres River
52. Tittabawassee River

* Locations where ruffe were captured. * * New ruffe discovery.

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Great Lakes Science Center - Lake Superior Biological Stn.

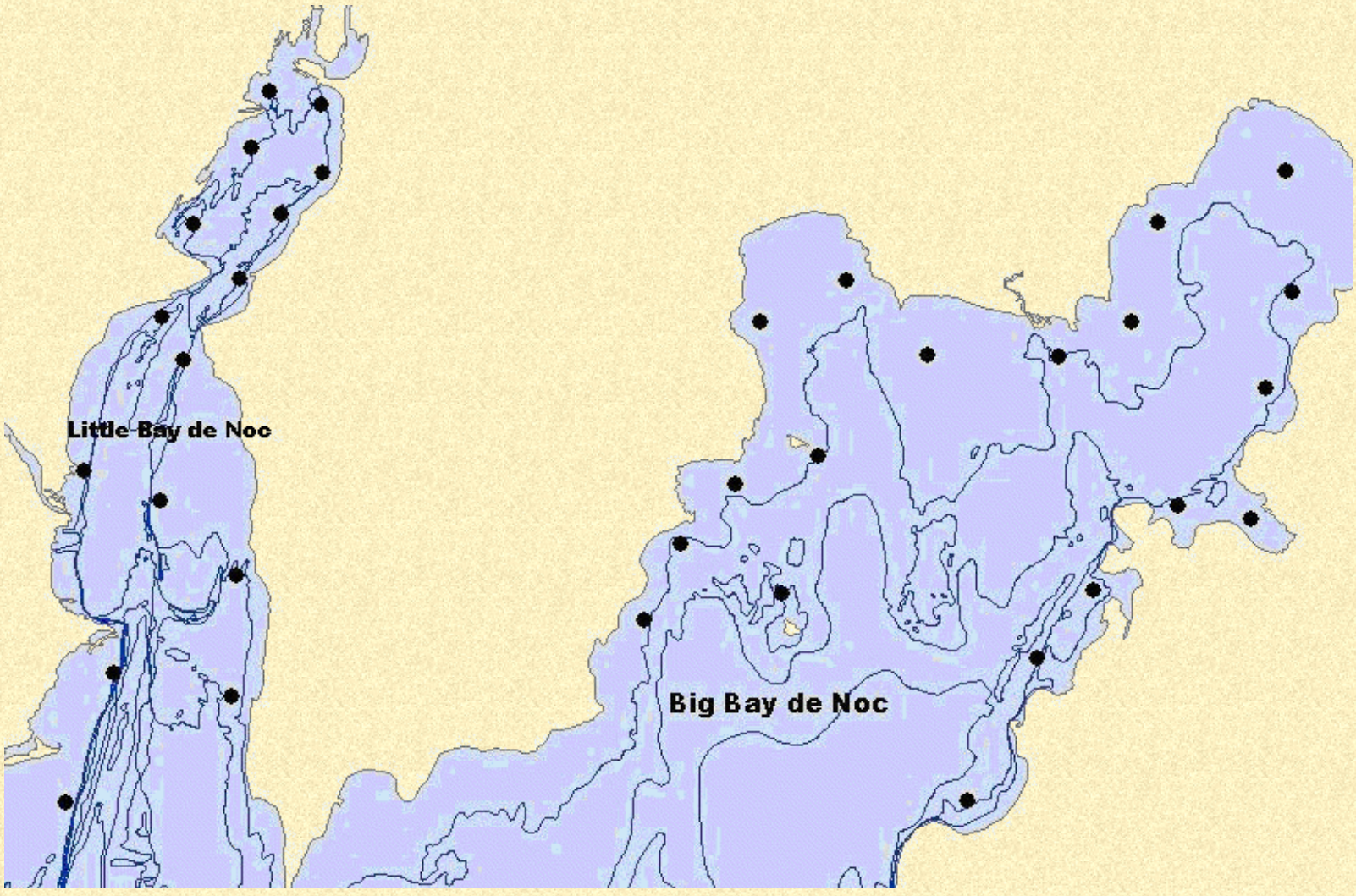
Figure 5. USGS bottom trawling locations in Lake Michigan, where ruffe were capable of incidental capture, 2005.


87°
85°
Manistique
45°
Sturgeon
Bay
Frankfort
LAKE MICHIGAN
Ludington
Latitude
Port
Washington
43°
Saugatuck
Waukegan
N
25 0 25 50
Kilometers
Canada
United
States
of
America
87°
Longitude
85°

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Michigan Department of Natural Resources

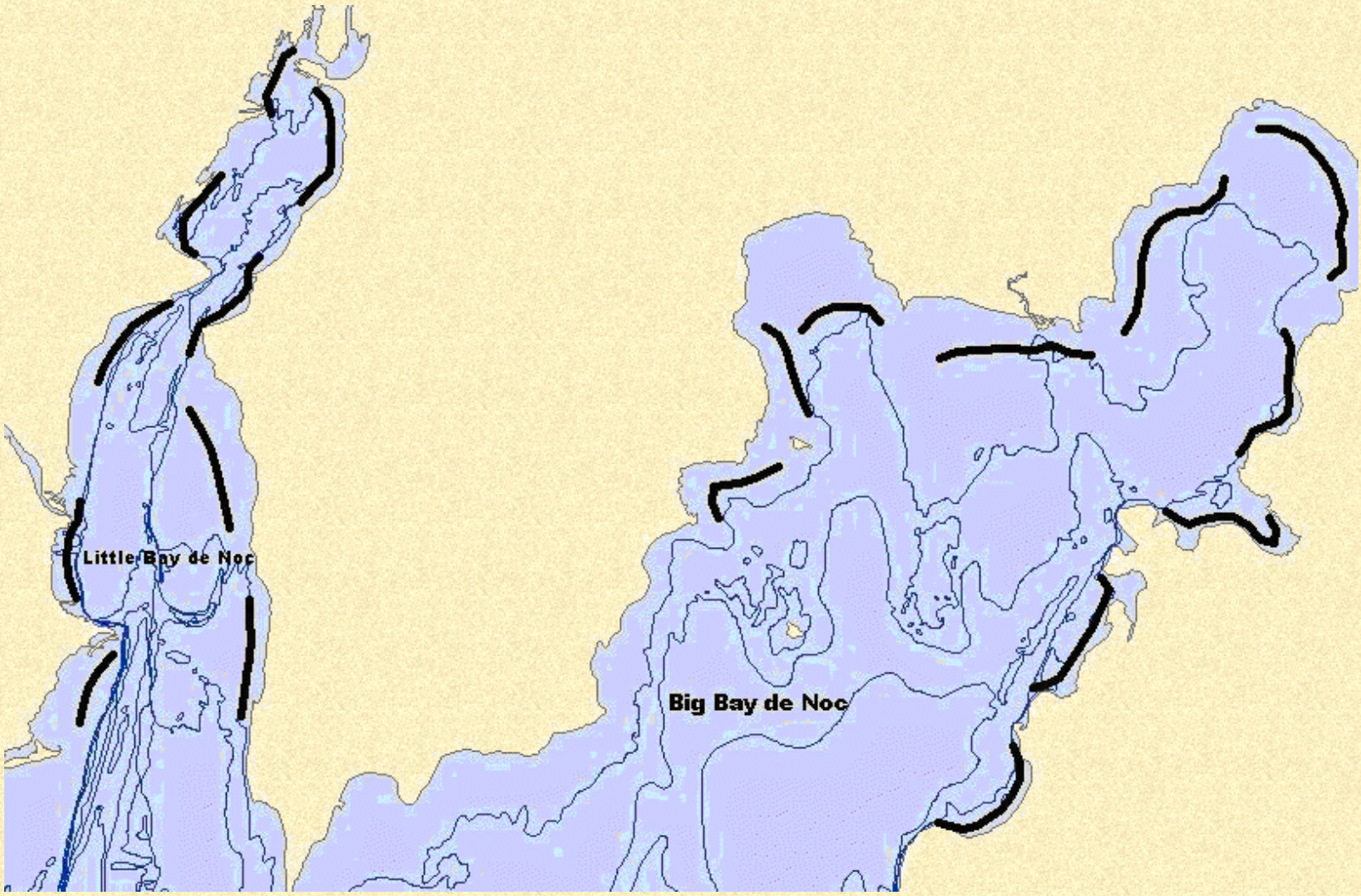
Figure 6. MIDNR gill net locations in northern Green Bay of Lake Michigan. In 2005, a subset of 12 sites from Big Bay de Noc and four sites from Little Bay de Noc were randomly selected and sampled. Ruffe were capable of incidental capture from this sampling. A total of 20 ruffe were captured in Little Bay de Noc. No ruffe were captured in Big Bay de Noc.



SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Michigan Department of Natural Resources

Figure 7. MIDNR electrofishing transects in northern Green Bay of Lake Michigan. In 2005, a subset of six transects from Big Bay de Noc and eight transects from Little Bay de Noc were randomly selected and sampled. Ruffe were capable of incidental capture from this sampling, but no ruffe were captured by this gear.



SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Great Lakes Science Center - Lake Superior Biological Stn.

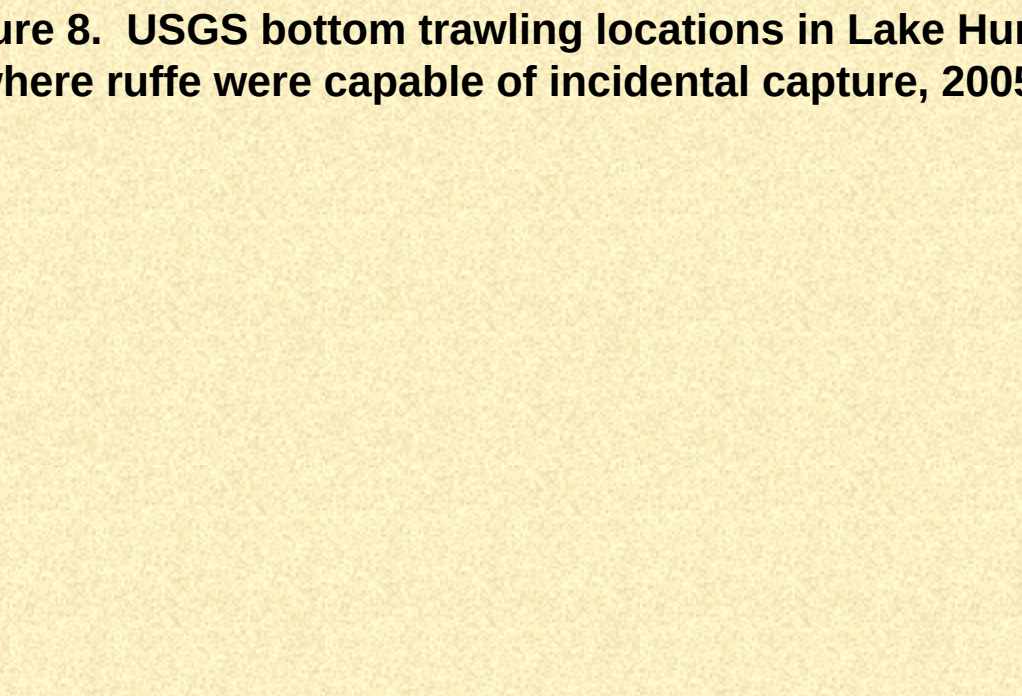


Figure 8. USGS bottom trawling locations in Lake Huron, where ruffe were capable of incidental capture, 2005.


Detour
(342)
Hammond Bay (305)
N
Alpena (308)
Lake Huron
Au Sable Point (311)
Harbor Beach (320)
(326) Goderich
0 12.5 25 50 Kilometers

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Figure 9. Dedicated locations surveyed for ruffe in U.S. waters of the Lower Great Lakes, 2005.


1
2
3
Ohio

Ontario

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Figure 10. Reported monitoring locations in U.S. waters of the Lower Great Lakes, where ruffe were capable of incidental capture, 2005.

Marquette Biological Station - Sea Lamprey Control (Trapping)

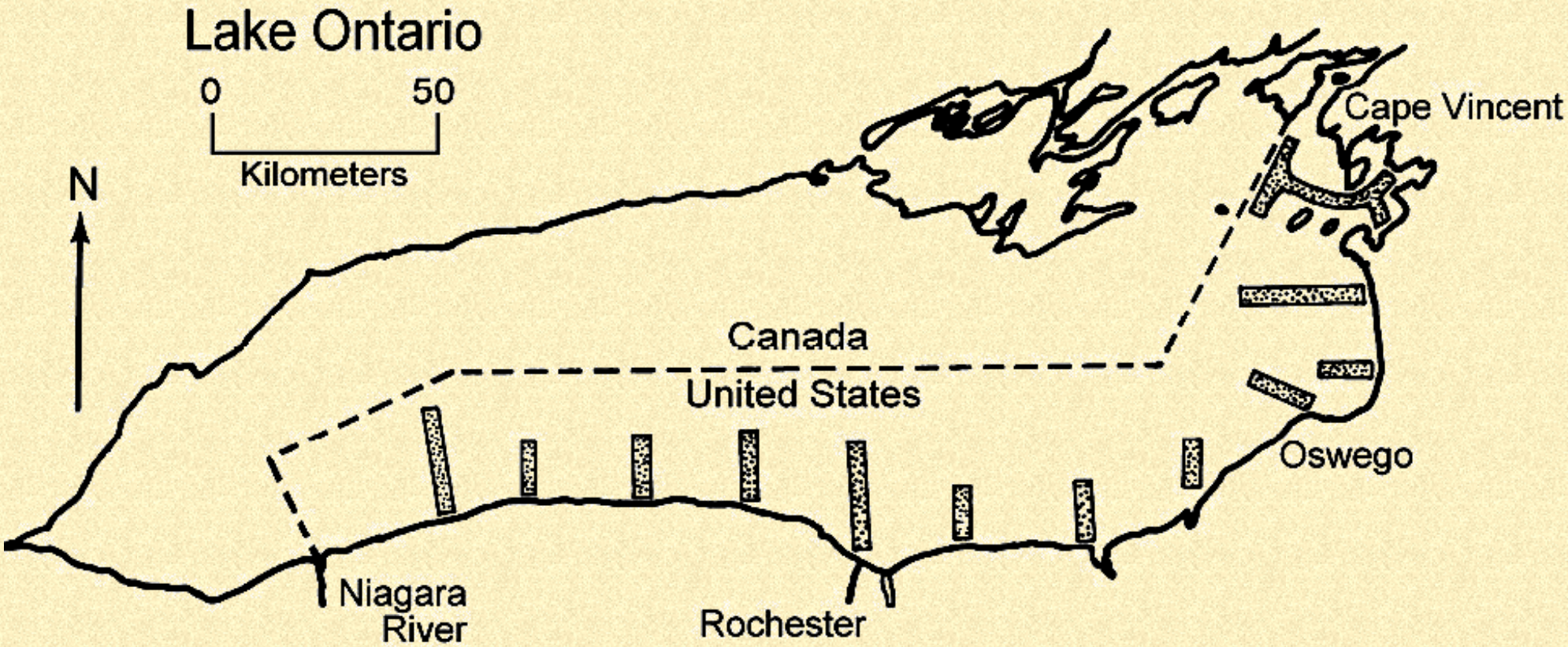
1. Black River, 2. Sterling Creek, 3. Sterling Valley Creek, 4. Cattaraugus Creek, 5. Grand River

Great Lakes Science Center – Lake Erie Biological Station (Bottom Trawling)

6. East Harbor State Park, Ohio

SURVEILLANCE FOR RUFFE IN THE GREAT LAKES, 2005

Figure 11. USGS/NYSDEC bottom trawling locations in Lake Ontario, where ruffe were capable of incidental capture, 2005.



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Great Lakes Science Center – Lake Ontario Biological Stn.

New York State Department of Environmental Conservation

Table 1. Summary of 2005 Ruffe Surveillance Effort in Lake Superior.

(On the Periphery and Outside of the Detected Ruffe Range)

Location	Agency	Effort *	Gear	Date	Ave. Btm. Temp (°C)	Ave. Depth (m)	Ave. Secchi (m)	RUFFE
Lake Superior (Dedicated Surveillance)								
Keweenaw Waterway (Pike Bay)**	FWS	15.00	BT-4.9	5/17/05	10.0	4.4	1.3	3
Keweenaw Waterway (Pike Bay)**	FWS	14.00	BT-4.9	9/27/05	17.0	4.2	1.0	1
Keweenaw Waterway (Portage Lake S. Entry)	FWS	15.00	BT-4.9	5/17/05	9.0	5.4	1.6	
Keweenaw Waterway (Portage Lake S. Entry)	FWS	15.00	BT-4.9	9/27/2005	18.0	6	3.3	
Keweenaw Waterway (South Entry)	FWS	10.00	BT-4.9	5/17/05	7.0	7.6	2.2	
Keweenaw Waterway (South Entry)	FWS	10.00	BT-4.9	9/27/05	17.0	7.5	3.2	
Pequaming Bay	FWS	28.00	BT-4.9	5/18/05	5.5	14.1	5.0	
Pequaming Bay	FWS	6 trapnights	MWT	5/18-19/05	5.8	3.4	5.4+	
Pequaming Bay	FWS	25.50	BT-4.9	9/28/05	17.0	8.0	6.3	
Pequaming Bay	FWS	2 trapnights	MWT	9/28-29/05	15.5	3.4	6.3	
Marquette Lower Harbor	FWS	24.00	BT-4.9	5/19/05	9.0	8.1	7.5****	
Marquette Lower Harbor**	FWS	25.00	BT-4.9	9/29/05	16.0	8.3	6.6****	1
Marquette Upper Harbor	FWS	20.00	BT-4.9	5/20/05	7.0	9.5	8.0+	
Marquette Upper Harbor	FWS	20.00	BT-4.9	9/29/05	16.0	10.1	5.6	
Munising Bay	FWS	15.00	BT-4.9	5/20/05	6.5	9.6	8.0+	
Munising Bay	FWS	6 trapnights	MWT	5/20-21/05	6.8	3.2	8.0+	
Munising Bay	FWS	18.00	BT-4.9	9/30/05	15.5	10.0	5.3	
Munising Bay	FWS	3 trapnights	MWT	9/30-10/1/05	15.5	3.3	5.3	
Grand Marais (West Bay)	FWS	63.00	BT-4.9	5/21/05	9.0	10.6	5.0	
Grand Marais (West Bay)	FWS	23.00	BT-4.9	10/1/05	15.0	10.9	2.2	
Tahquamenon River	FWS	29.00	BT-4.9	5/22/05	13.8	4.2	1.1	
Tahquamenon River	FWS	6 trapnights	MWT	5/22-23/05	13.5	4.2	1.1	
Tahquamenon River	FWS	20.00	BT-4.9	10/2/05	15.0	2.3	1.8	
Tahquamenon River	FWS	3 trapnights	MWT	10/2-3/05	15.5	3.0	1.8	
Tahquamenon River	FWS	3 trapnights	FN	10/2-3/05	15.5	0.9	1.8	
								RUFFE
TOTALS		6.49 hours.	BT-4.9					**5**
		26 trapnights	MWT					**0**
		3 trapnights	FN					**0**
		Total Ruffe (Dedicated Surveillance)						**5**

Lake Superior (Reported Sampling Capable of Capturing Ruffe Incidentally)						Range of Depth (m)		
Ausable Point	MIDNR	732 meters	GN-50/56/63/69	8/29-30/05		36-72		
Betsy River	FWS	82 trapnights	PAT	5/4-6/14/05	15.6	0.5		
Big Garlic River	PC	59 trapnights	FN	4/26-6/24/05	16.3	0.5-1.0		
Blind Sucker	FWS	244 meters	GN-50/63	7/20-26/05	18.0	53-189		
Deer Park	FWS	244 meters	GN-50/63	7/20-26/05	17.5	65-229		
Furnace Creek	PC	58 trapnights	PAT	4/27-6/24/05	15.3	0.5		
Grand Marais	FWS	244 meters	GN-50/63	7/20-26/05	18.0	53-238		
Grand Portal-IN	MIDNR	732 meters	GN-50/56/63/69	8/30-31/05		24-66		
Grand Portal-Out	MIDNR	732 meters	GN-50/56/63/69	8/30-31/05		38-68		
Huron Bay	KB/FWS	40 kilometers	BEL					
Isle Royale	FWS	51 kilometers	BEL	6/10-17/05	11.0			
Isle Royale	FWS	2,906 meters	BPEL	6/12,15-16; 9/9-10,12-13,15	17.0			
Isle Royale	FWS	20 trapnights	FN	6/8-10/05	8.0	1.3		
Kelsey Creek	KB	610 meters	BPEL					
Keweenaw Bay	KB	2,744 meters	GN-50/63					
Keweenaw Bay	KB/FWS	40 kilometers	BEL					
Little Silver Creek	KB	610 meters	BPEL					
Miners River	NPS/FWS	94 trapnights	PAT	5/4-6/20/05	13.2	0.5		
Misery River**	GLIFWC	90 trapnights	PAT	5/8-6/22/05	14.8	0.5		1
Nearshore/Offshore Lake Superior	USGS	1,200.00 minutes	BT-11.9	4/27-6/18/05		15.0-249.0		
Perry's Landing	MIDNR	732 meters	GN-50/56/63/69	8/29-30/05		30.0-59.0		
Rock River	FWS	92 trapnights	PAT	5/5-6/20/05	14.5	0.5		
Silver River	GLIFWC	47 trapnights	FN	5/8-6/24/05	16.7	0.5-1.0		
Tahquamenon River	FWS	129 trapnights	PAT	5/4-6/16/05	15.3	0.5		
Thunder Bay***	USGS	60.00 minutes	BT-11.9	11/18/05	5.3	23.0-29.0		1
Torch Lake (Keweenaw Waterway)***	MIDNR		HL	9/5/05				1
								RUFFE
Totals			HL					**1**
		6,404 meters	GN					**0**
		126 trapnights	FN					**0**
		545 trapnights	All Traps					**1**
		131 kilometers	BEL					**0**
		4,126 meters	BPEL					**0**
		21.00 hours	BT-11.9					**1**
		Total Ruffe (Reported Sampling Capable of Capturing Ruffe Incidentally)						**3**
		Total Ruffe (Dedicated Surveillance)						**5**
		Total Ruffe (All Reported Sampling Capable of Capturing Ruffe)						**8**

Key to Agency:

FWS = U.S. Fish & Wildlife Service
USGS = U.S. Geological Survey
NPS = National Park Service
MIDNR = Michigan Department of Natural Resources
GLIFWC = Great Lakes Indian Fish & Wildlife Commission
KB = Keweenaw Bay Tribal Natural Resources Dept.
PC = Private Contractor

Key to Gear:

BT-4.9 = Bottom Trawl (4.9 m Headrope)
BT-11.9 = Bottom Trawl (11.9 m Headrope)
BEL = Boom Electrofishing
BPEL = Backpack Electrofishing
FN = Fyke Net
MWT = Modified Windermere Trap
PAT = Portable Assessment Trap
GN-50 = Gill Net (50 mm stretch mesh)
GN-56 = Gill Net (56 mm stretch mesh)
GN-63 = Gill Net (63 mm stretch mesh)
GN-69 = Gill Net (69 mm stretch mesh)
HL = Hook & Line

* Unless specified, effort is in minutes trawl was on bottom.

** Locations where ruffe were captured.

*** New Ruffe Discovery

**** Average secchi reading does not include transect where ruffe were captured

Table 2. Summary of Reported 2005 Sampling Capable of Incidental Ruffe Capture in Lake Michigan.

(Including Little & Big Bays de Noc where ruffe were detected previously)

Location	Agency	Effort *	Gear	Date	Ave. Btm. Temp (°C)	Ave. Depth (m)	RUFFE
Lake Michigan							
Betsie River	GTB	148 trapnights	PAT	4/18-7/1/05	16.3		
Big Bay de Noc	MIDNR	150.00 minutes	BT	Jun/Jul/Aug/05			
Big Bay de Noc	MIDNR	220 meters	GN-exp	Jun/Jul/Aug/05		4.6	
Big Bay de Noc	MIDNR	2,195 meters	GN-25	Sep/Oct/05			
Big Bay de Noc	MIDNR	2,195 meters	GN-38	Sep/Oct/05			
Big Bay de Noc	MIDNR	2,195 meters	GN-50	Sep/Oct/05			
Big Manistee River	FWS/LBS	122 trapnights	PAT	4/15-6/15/05	13.8	0.5	
Boardman River	GTB	130 trapnights	PAT	4/19-6/23/05	16.7 (Surface)	0.5	
Carp Lake Outlet	LTBBOI	76 trapnights	PT	5/9-6/24/05	15.3 (Surface)	0.8	
Deer Creek	PC	116 trapnights	PAT	4/14-6/11/05	14.1	0.5	
Hog Island Creek	PC	60 trapnights	FN	4/19-6/18/05	12.5	0.5-1.0	
Jordan River	PC	152 trapnights	FN	2/28-7/30/05	12.3	1.0	
Little Bay de Noc**	MIDNR	150.00 minutes	BT	Jun/Jul/Aug/05		5.9	1 (Aug)
Little Bay de Noc**	MIDNR	220 meters	GN-exp	Jun/Jul/Aug/05	17.0	3.8	1 (Jun)
Little Bay de Noc**	MIDNR	732 meters	GN-25	9/23 &10/14/05	16.0	2.1	2 (Sep)
Little Bay de Noc**	MIDNR	732 meters	GN-38	9/23 &10/14/05	16.0	2.6	14
Little Bay de Noc**	MIDNR	732 meters	GN-50	9/23 &10/14/05	16.0	3.1	4
Little Manistee River	FWS/LBS	188 trapnights	PAT	4/10-7/13/05	13.7		
Manistique River	FWS/MBS	51 trapnights	MT	4/25-6/15/05	15.6	0.5	
Menominee River	FWS/MBS	45 trapnights	PAT	4/25-6/9/05	14.9 (Surface)		
Oconto River	FWS/MBS	43 trapnights	PAT	4/27-6/9/05	15.3 (Surface)		
Ogontz River	PC	57 trapnights	FN	4/21-6/17/05	12.4	0.5-1.0	
Pere Marquette River	FWS/LBS	131 trapnights	PT	3/20-7/29/05	13.4 (Surface)		
Peshtigo River	FWS/MBS	98 trapnights	PAT	4/22-6/10/05	15.8 (Surface)		
St. Joseph River	PC	160 trapnights	PAT	3/8-5/27/05	13.2 (Surface)	0.5	
Nearshore/Offshore	USGS	700.00 minutes	BT-12	9/7-28/05	3.7-20.1	9.0-110.0	
							RUFFE
TOTALS		5.00 hours	BT				**1**
		11.67 hours	BT-12				**0**
		269 trapnights	FN				**0**
		1,308 trapnights	Traps				**0**
		440 meters	GN-exp				**1**
		2,927 meters	GN-25				**2**
		2,927 meters	GN-38				**14**
		2,927 meters	GN-50				**4**
	Total Ruffe (Reported Sampling Capable of Capturing Ruffe Incidentally)						**22**

Key to Agency: MIDNR = Michigan Department of Natural Resources
PC = Private Contractor
GTB = Grand Traverse Band of Ottawa and Chippewa Indians
MBS = Marquette Biological Station - FWS
LBS = Ludington Biological Station - FWS
LTBBOI = Little Traverse Bay Band of Ottawa Indians

Key to Gear: BT = Bottom Trawl
BT-4.9 = BT (4.9m Headrope)
BT-12 = BT (12m Headrope)
PT = Permanent Trap
MT = Mechanical Trap
PAT = Portable Assessment Trap
FN = Fyke Net
GN-exp = Experimental Gill Net
GN-25 = Gill Net (25 mm stretch mesh)
GN-38 = Gill Net (38 mm stretch mesh)
GN-50 = Gill Net (50 mm stretch mesh)

* Unless specified, effort is in minutes trawl was on bottom.
**Locations where ruffe were captured

Table 3. Summary of 2005 ruffe surveillance efforts in U.S. waters of Lake Huron.

(Includes Thunder Bay & Thunder Bay River where ruffe were detected previously)

Location	Agency	Effort *	Gear	Date	Ave. Btm. Temp (°C)	Ave. Depth (m)	RUFFE
Lake Huron (Dedicated Surveillance)							
Cheboygan River	FWS	30.00	BT-4.9	9/28/05	18.2	6.9	
Port Dolomite	FWS	30.00	BT-4.9	9/26/05	13.9	6.9	
St. Mary's River (Above Locks)	FWS	32.00	BT-4.9	9/27/05	17.8	9.3	
St. Mary's River (Baie de Wasai)	FWS	30.00	BT-4.9	9/27/05	16.4	4.8	
St. Mary's River (De Tour Passage)	FWS	23.00	BT-4.9	9/26 & 28/05	17.3	6.6	
St. Mary's River (SSM Municipal Harbor)	FWS	30.00	BT-4.9	9/27/05	18.0	3.8	
St. Mary's River (South Sugar Island Ferry)	FWS	30.00	BT-4.9	9/27/05	17.8	9.1	
Thunder Bay (Lafarge Shipping Channel)	FWS	5.00	BT-4.9	10/24/05	11.1	8.4	
Thunder Bay (River Shipping Channel)	FWS	60.00	BT-4.9	10/20/05	12.2	6.1	
Thunder Bay River	FWS	30.00	BT-4.9	10/20/05	11.5	6.4	
Thunder Bay River	FWS	90 nights	GN	4/12 - 5/27/05	11.4	3.2	
Thunder Bay River	FWS	9 nights	GN	10/11-14/05	14.8	2.7	
							RUFFE
TOTALS		5.00 hours	BT-4.9				**0**
		99 nights	GN				**0**
		Total Ruffe (Dedicated Surveillance)					**0**
Lake Huron (Sampling Capable of Capturing Ruffe Incidentally)							
Albany Creek	CORA	58 trapnights	PAT	4/25-6/22/05	11.8	0.5	
AuSable River	PC	142 trapnights	PAT	4/9-6/10/05	11.9 (Surface)	UNK	
Carp River	CORA	174 trapnights	FN	4/25-6/22/05	12.9	0.5-1.0	
Cheboygan River	FWS/MBS	276 trapnights	PT/PAT	4/25-7/3/05	14.6 (Surface)	1.0	
Devils River	PC	71 trapnights	FN	4/9-6/10/05	13.6	0.5-1.0	
East AuGres River	PC	71 trapnights	PAT	4/9-6/10/05	12.5 (Surface)	UNK	
Greene Creek	FWS/MBS	59 trapnights	PAT	4/22-6/20/05	14.2	0.5	
Nunns Creek	CORA	42 trapnights	PAT	5/9-6/20/05	13.5	0.5	
Ocqueoc River	FWS/MBS	130 trapnights	MT	4/21-6/25/05	15.9 (Surface)	0.4	
St. Marys River	LSSU/MBS	660 trapnights	PAT	6/1-7/31/05	15.4 (Surface)	UNK	
Tittabawassee River	DC	37 trapnights	MT	4/20-5/27/05	14.3	0.3-0.5	
Trout Creek	CORA	56 trapnights	FN	4/25-6/20/05	13.8	0.5-1.0	
Trout River	FWS/MBS	56 trapnights	MT	4/21-6/16/05	13.5	0.2	
Nearshore/Offshore	USGS	430.00 minutes	WT-21	Oct/Nov		27.0-73.0	
							RUFFE
		7.17 hours	BT-21				**0**
TOTALS		301 trapnights	FN				**0**
		1,531 trapnights	Traps				**0**
		Total Ruffe (Sampling Capable of Capturing Ruffe Incidentally)					**0**
		Total Ruffe (Dedicated Surveillance)					**0**
		Total Ruffe (All Sampling Capable of Capturing Ruffe)					**0**

Key to Agency:

FWS = U.S. Fish & Wildlife Service
MBS = Marquette Biological Station, FWS
USGS = U.S. Geological Survey
CORA = Chippewa Ottawa Resource Authority
LSSU = Lake Superior State University
DC = Dow Chemical-USA
PC = Private Contractor

Key to Gear:

BT-4.9 = Bottom Trawl (4.9m Headrope)
WT-21 = 21m Wing Trawl
GN-38 = Gill Net (38mm stretch mesh)
FN = Fyke Net
PAT = Portable Assessment Trap
MT = Mechanical Trap

UNK = Unknown

* Unless specified, effort is in minutes trawl was on bottom.

Table 4. Summary of 2005 ruffe surveillance effort in U.S. waters of the Lower Great Lakes.

Location	Agency	Effort*	Gear	Date	Depth (m)	Sf. Temp. (C)	Bt. Temp. (C)	Sf. DO (ppm)	Bt. DO (ppm)	Secchi (m)	RUFFE
Lake Erie (Dedicated Surveillance)											
Ashtabula Harbor	FWS	42.58	BT-4.9	5/26/05	8.9	13.1	11.1	8.8	9.5	0.7	
Ashtabula Harbor	FWS	40.00	BT-4.9	9/28/05	8.2	20.7	20.4	7.7	7.5	0.8	
Buffalo Harbor	FWS	52.72	BT-4.9	5/17/05	7.4	12.9	12.1	8.9	9.5	2.4	
Buffalo Harbor	FWS	39.00	BT-4.9	10/4/05	6.9	20.0	19.3	8.5	7.9	3.7	
Cleveland Harbor	FWS	62.15	BT-4.9	5/25/05	8.3	13.3	12.9	9.2	9.3	1.1	
Cleveland Harbor	FWS	60.00	BT-4.9	9/27-28/05	7.9	21.3	21.1	7.2	6.6	0.9	
Conneaut Harbor	FWS	30.83	BT-4.9	5/26/05	8.0	14.3	10.8	9.2	9.4	1.0	
Conneaut Harbor	FWS	30.00	BT-4.9	9/28/05	7.1	20.5	20.3	7.9	7.7	1.0	
Erie Harbor	FWS	42.65	BT-4.9	5/27/05	8.1	16.2	15.6	8.9	9.1	2.4	
Erie Harbor	FWS	40.66	BT-4.9	10/6/05	7.6	19.7	19.5	7.6	7.5	1.5	
Sandusky Harbor	FWS	32.11	BT-4.9	5/23/05	7.3	16.4	16.2	10.2	9.8	0.6	
Sandusky Harbor	FWS	30.12	BT-4.9	9/26/05	7.0	21.3	21.3	8.1	7.6	0.4	
Maumee River	FWS	40.75	BT-4.9	5/24/05	9.0	16.6	16.6	7.2	7.0	0.4	
Maumee River	FWS	40.50	BT-4.9	9/27/05	8.6	21.4	21.2	5.3	4.7	0.3	
											RUFFE
TOTALS		9.73 hours	BT-4.9								**0**
		Total Ruffe (Dedicated Surveillance)									**0**
Lake Erie (Sampling Capable of Capturing Ruffe Incidentally)											
Cattaraugus Creek	PC	102 trapnights	PAT	5/6-6/26/05	0.5		16.3				
Grand River	PC	112 trapnights	PAT	4/11-6/6/05	0.5		15.0				
Spooner Creek	PC	100 trapnights	PAT	5/7-6/26/05	0.5		13.2				
Nearshore/Offshore	USGS	720.00 minutes	BT-7.9	Summer/Fall	3.0-6.0						
											RUFFE
		12.00 hours	BT-7.9								**0**
TOTALS		314 trapnights	PAT								**0**
		Total Ruffe (Sampling Capable of Capturing Ruffe Incidentally)									**0**
		Total Ruffe (Dedicated Surveillance)									**0**
		Total Ruffe (All Sampling Capable of Capturing Ruffe)									**0**
Lake Ontario (Dedicated Surveillance)											
Genesee River	FWS	44.00	BT-4.9	5/18/05	6.3	15.4	14.5	8.7	8.8	0.7	
Genesee River	FWS	42.88	BT-4.9	10/5/05	5.6	19.9	19.0	7.2	6.8	0.7	
											RUFFE
TOTALS		1.45 hours	BT-4.9								**0**
		Total Ruffe (Dedicated Surveillance)									**0**
Lake Ontario (Sampling Capable of Capturing Ruffe Incidentally)											
Black River	PC	134 trapnights	PAT	4/11-6/17/05	UNK	13.9					
Sterling Creek	PC	62 trapnights	PAT	4/5-6/6/05	0.5		14.7				
Sterling Valley Creek	PC	62 trapnights	PAT	4/5-6/6/05 4/19-5/3/05	0.5-1.0		14.8				
Nearshore/Offshore	USGS/ NYSDEC	2,630.00 minutes	BT-18	6/1-10/05 10/11-28/05	8.0-170.0						
											RUFFE
TOTALS		43.83 hours	BT-18								**0**
		258 trapnights	PAT								**0**
		Total Ruffe (Sampling Capable of Capturing Ruffe Incidentally)									**0**
		Total Ruffe (Dedicated Surveillance)									**0**
		Total Ruffe (All Sampling Capable of Capturing Ruffe)									**0**

Key to Column Headings: Sf. Temp = Surface Temperature; Bt. Temp. = Bottom Temperature; Sf. DO = Surface Dissolved Oxygen; Bt. DO = Bottom Dissolved Oxygen

Key to Agency: FWS = U.S. Fish & Wildlife Service; USGS = U.S. Geological Survey; NYSDEC = New York State Department of Environmental Conservation; PC = Private Contractor

Key to Gear: BT-4.9 = Bottom Trawl (4.9m Headrope); BT-7.9 = Bottom Trawl (7.9m Headrope); BT-18 = Bottom Trawl (18.0m Headrope); PAT = Portable Assessment Trap

UNK = Unknown

* Unless specified, effort is in minutes trawl was on bottom.